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Heavy Oil Engines

Submarine Boats E-1 and E-2 are Fitted with Engines of the Diesel Type, the first to be used for Marine Purposes in the United States-- Advantage of the Design



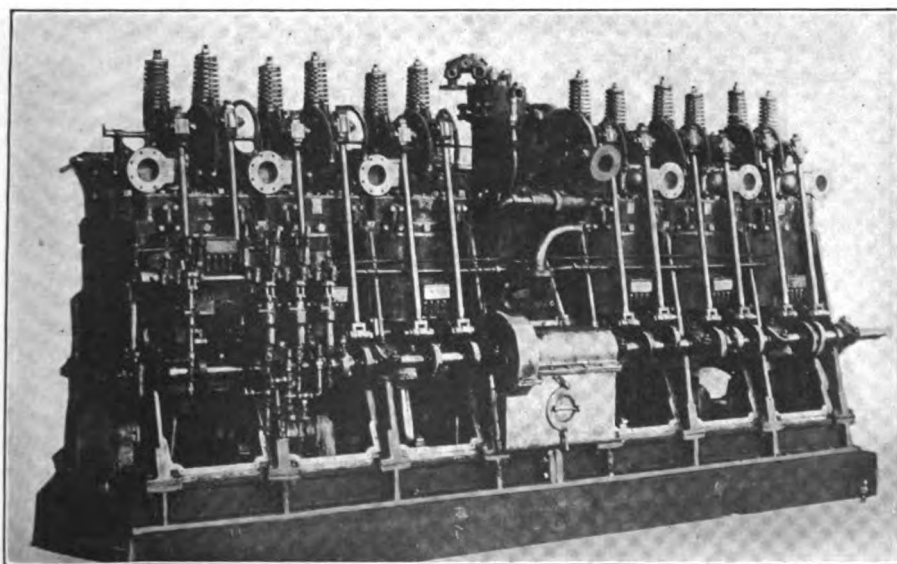
THE oil engines in Submarines E-1 and E-2 are primarily of interest for the reason that they are the first heavy oil engines which have ever been used in the United States navy, and so far as is known they are the first heavy oil engines working on the Diesel principle which have ever been used for marine purposes in the United States.

The Diesel principle on which these engines work has been well known for many years, and is employed in engines for stationary use to a very large extent. For the benefit of the readers who may not be already familiar with this principle, it is sufficient to state that an explosive mixture

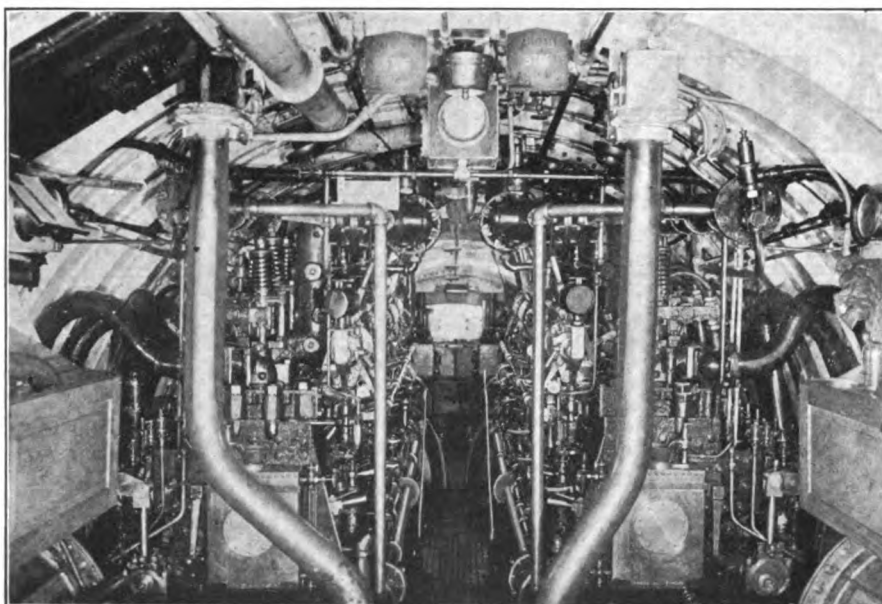
is not used in these engines. On the compression stroke the cylinder is filled with pure air, which is compressed to about 500 lbs. pressure per sq. in. Due to this sudden compression the temperature of the air is raised to approximately 1,000 degrees Fahr. At the end of the compression stroke, fuel (practically any form of oil may be used) is sprayed into this hot air, and on coming in contact therewith, is burned. This further raises the temperature of the air inside the cylinder so that on the return stroke it expands under approximately constant pressure so long as the fuel is sprayed in, which is generally about 1/10 of the stroke. As soon as the

fuel spray valve is closed combustion ceases and the hot air and products of combustion then expand to the end of the stroke. Working on this principle carburetors and ignition devices are dispensed with. The control of the engine is obtained by the regulation of the amount of oil which is sprayed into the cylinders. There is no throttle as in the case of gasoline engines. There is no question of rich or lean mixtures for the reason that the fuel which is sprayed in is burned completely even when injected in very small amounts.

The advantages of an engine working on this principle, aside from certain mechanical features, have lately come into general recognition. The principal advantage is economy. On the average the fuel consumption of engines working on this principle is about one-half pound of fuel per brake horsepower hour. In certain large units this consumption has been reduced in special cases to less than 4-10 of a pound per horsepower hour. The fuel used is generally what is known commercially as fuel oil, which is a residue from oil refineries which is left over after all the more valuable commercial products have been removed. The price of this fuel oil varies in different sections of the country. In many places it can be bought for 2 cents per gallon, while in certain other sections it costs as much as 4 cents per gallon. In Europe the price of this oil is about 4 cents per gallon. Even at this highest price this fuel when used in en-



400-H. P. ENGINE OF SUBMARINE F-1



ENGINE ROOM SUBMARINE E-I, LOOKING AFT

gines working on the Diesel principle is generally regarded as the cheapest form of motive power, and it is undoubtedly due to this reason that such rapid development has been made abroad with this engine.

There are many other economies to be effected by the use of these engines, aside from the cost of fuel. These relate to attendance and upkeep. For military purposes there are other reasons why the use of these engines is recommended. Aside from the question of cost, safety may be mentioned as one of these reasons, especially on submarine boats where the use of a volatile liquid, like gasoline, is attended with considerable danger. But the most important military reason for the use of oil engines is due to the great saving in weight, both in fuel and power plant, and the consequent increased radius of action which may be obtained, or if much increased radius of action is not required the saving in weight effected can be most advantageously employed by devoting this saving to increased armor and armament. For the above reasons practically all governments interested in submarines decided on the adoption of oil engines within the past few years for use on such vessels. Hence, we now have the oil engines in E-1 and E-2, which are only the first of a considerable number of submarines now building which will be equipped in a like manner.

E-1 and E-2 are twin screw boats, each having a pair of four-cylinder, four-cycle non-reversible engines. The engines were made non-reversible for the reason that the boats were also equipped with powerful electric motors and storage batteries. The motors are on the main line of shafting and

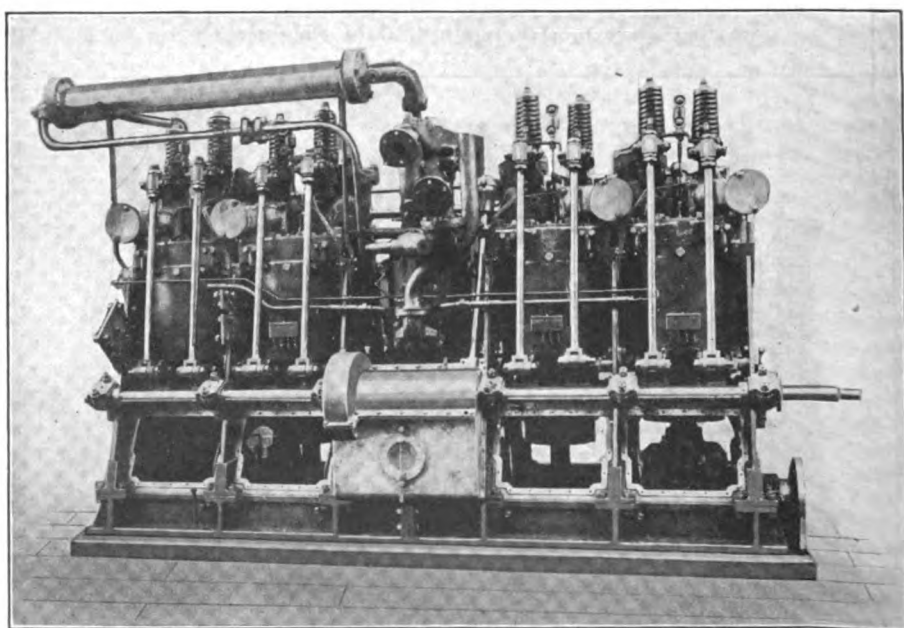
have a friction clutch interposed between them and the engines. For maneuvering it only becomes necessary to throw out the clutch and switch in the motor for backing, or for quickly going ahead. This system has been in use for many years in submarines throughout the world and for all practical purposes is as satisfactory as a reversible engine (some recent engines, however, working on the two-cycle principle, have been made reversible and will be installed in the later boats).

Construction of the Engine

The engines have developed 300 horsepower each when running at 400 revolutions per minute. The diameter of the cylinders is $12\frac{3}{4}$ in. and the

stroke $13\frac{1}{2}$ in. The construction of the engine differs considerably from any of the usual types of gasoline engines. The only cast iron used in its construction is in the cylinder and pistons. The crankshaft is of high grade nickel steel and is very heavy in construction. A large factor of safety has been allowed in this, as well as in the strength of the engine throughout. The bedplate is of cast steel. There is no housing, in the usual sense of the word. The cylinders are supported on frames made of steel plate securely riveted to the bedplate. Aluminum doors are placed between these frames, thus forming a closed-in crank pit, which in outward appearance resembles the usual housing. The cylinder heads are of cast steel. In order to obtain as nearly as possible perfect castings, the cylinders were cast without jackets. Jackets formed of welded steel plates were later shrunk on over the flanges extending from the ends of the cylinders. The cam shaft, cams and valves are the same in principle as those of a gasoline engine. With the view of great durability and strength they have been designed with a large factor of safety and have the appearance of being very large in proportion to the size of the engine.

The cranks are arranged in the same order as those in the ordinary gasoline four-cycle engine, except that between Nos. 2 and 3 cranks there is interposed an air compressor. This compressor is of two stages, single-acting, the pistons being arranged in tandem. The first stage compresses air to about 100 lbs. per square inch, and the second stage from 100 to 1,000 lbs. The air so compressed is used



300-H. P. ENGINE OF SUBMARINE E-I

for spraying fuel into the cylinders. Each cylinder is equipped with a fuel pump which delivers the fuel oil to the spray valves in which it is mixed with the spray air and injected by the latter into the cylinder when the spray valve opens. Each cylinder is practically an independent unit. One or more cylinders can be cut out if desired for the purpose of running at very slow speeds, or in case of accident to one or more cylinders the engine could, if necessary, be made to run with the remaining cylinders. Circulating water is obtained by means of a rotary pump driven by the main shaft. Forced lubrication is used throughout; two lubricating pumps being fitted although only one pump is required at a time, the other being held in reserve.

These engines were built by the

Electric Boat Co., contractors for submarines E-1 and E-2. Engines according to the same general design, but having six cylinders and developing 400 horsepower, are installed on submarines F-1 to F-4. F-1 and F-2 were built by the Electric Boat Co. at the works of the Union Iron Works Co., at San Francisco, Cal., and F-3 and F-4, were built by the Electric Boat Co. at the works of the Moran Co., of Seattle, Wash. E-1 and E-2 were built by the Electric Boat Co. at the works of the Fore River Shipbuilding Co., Quincy, Mass. For the boats now under construction by the Electric Boat Co., the engines will be built by the New London Ship & Engine Co., of Groton, Conn. The latter engines are the two-cycle reversible type developed by the Maschinenfabrik Augsburg-Nürnberg, A. G. The

New London company is now operating under a license from the above named German firm. E-1 and E-2 had their official trials off Provincetown last winter. The contractors were well pleased with the results obtained. The fuel consumption came within the amount originally contemplated. The actual consumption was 0.515 lb. per brake horsepower hour.

Doubtless further progress in the art will show considerable improvement over the engines of E-1 and E-2, but considering that they are the pioneer boats, with absolutely no experience in this country to fall back upon, the results obtained are considered very creditable, and these boats will always have the distinction of having been the first in this country to be equipped with heavy oil engines.

The Diesel Oil Engine*

Relative Possibilities of the Diesel Oil Engine, as Compared With the Reciprocating Engine for Marine Propulsion

By E. Orde

ALTHOUGH much has been written on the subject of the Diesel engine as applied to the propulsion of sea-going vessels it appears to the writer that the extent to which the earning power of a cargo vessel is affected by the adoption of this type of engine has not so far received the consideration at the hands of engineers and shipbuilders which it deserves. The importance of this question as a basis for discussion lies in the fact that a careful consideration of the best arrangements that can be made to utilize as far as possible the advantages of the Diesel engine, involves a number of points which in the present state of knowledge of the possibilities of this engine must be considered controversial if not largely conjectural. As a simple way of opening these questions the writer submits two outline plans, Fig. 1 and Fig. 2, which are here reproduced. Fig. 1 shows a shelter-deck cargo steamer, one of a number at present at work, and Fig. 2 the same vessel re-arranged and fitted with Diesel engines. The general particulars of the two vessels are as follows:—Length over all, 412 ft.; length b. p., 400 ft.; breadth, 52 ft.; depth, 29 ft. 9 in.

*A discussion introduced April 1, 1912, by E. L. Orde, the Hon. Sir Charles A. Parsons, K. C. B., F. R. S., R. J. Walker, and A. C. Holzapfel, before the North-East Coast Institution of Engineers and Shipbuilders, Newcastle-on-Tyne.

An estimate of the cost of working the two vessels is given in Table I as a model of the calculations that have been made with a view of showing the limits of fuel cost within which

bunkers in both vessels are arranged accordingly. The position of the engine room in the Diesel ship is on the whole the most suitable in view of trim and ballast draught requirements,

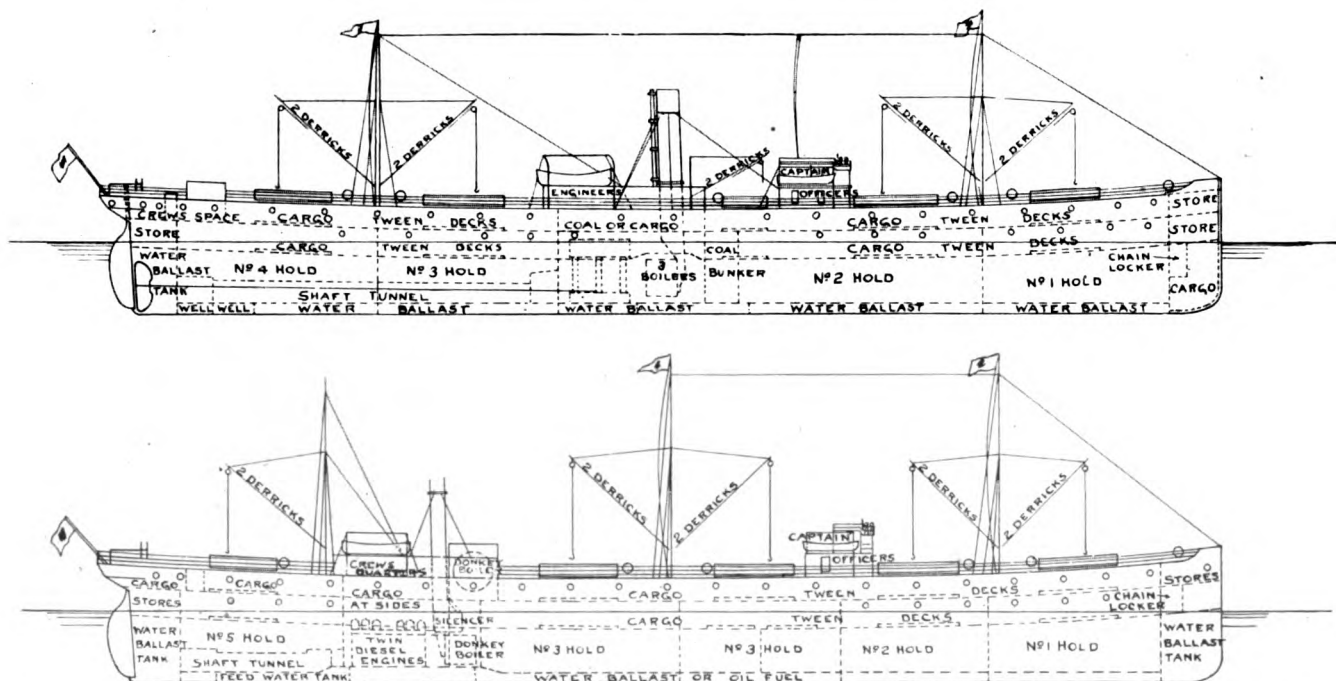
	Steam Engines.	Diesel Engines.
Gross tonnage	4,655	4,800
Net tonnage	2,930	3,030
Draught	26 ft. 1 in.	26 ft. 1 in.
Total dead weight (tons)	8,640	8,775
Average sea power	2,430 I. H. P.	2,150 B. H. P.
Average sea speed in knots	10½	10½
Radius of action in knots	3,500	3,500
Fuel consumption, tons per day	42	12.7
	(= 2,430 I. H. P. at 1.6 lb. per I. H. P. hour.)	(2,150 at 0.55 lb. per B. H. P. per hour.)
Freight-earning cargo in tons	7,880	8,530
Freight-earning cargo per ton, total d. w.	.914	.972
Freight-earning cargo per ton, gross register ..	1.69	1.77
Freight-earning cargo per ton, net register ..	2.68	2.82
Capacity for cargo (grain) in cubic feet	488,300	523,800
Cargo capacity per ton freight-earning cargo in cubic feet...	62	61.5

either type of propelling machinery may work economically. Such estimates can, of course, only be regarded as approximate, as the local conditions of particular trades, such as the convenient distribution of fuel stations, and many other influences, which only shipowners can assess at their true value, must exercise considerable effect upon them: but as most of the items in the estimate are common to both ships the general comparison is probably sufficiently accurate to form a basis for discussion.

The unit of 3,500 mile tons is taken as the cost of working, as this represents a fair average voyage, and the

but the saving on the weight of the machinery and bunkers makes a deep tank necessary. The hull of the Diesel ship is more costly than that of the steamer because of the fittings for twin screws, and the cost of oil-tight bunkers in addition to the deep tank.

The oil-tight bunkers are all in the double bottom for though it is perhaps open to question whether this is the best arrangement, it is made imperative in this case if the cubic capacity per ton of freight-earning cargo is to be equal to that of the steamer. The machinery space is as short as is compatible with a conven-



FIGS. 1 AND 2—OUTLINE PLANS OF A SHELTER-DECK CARGO STEAMER, FITTED WITH STEAM ENGINES (FIG. 1) AND WITH DIESEL ENGINES (FIG. 2)

ient engine room arrangement, and the register tonnage of the two vessels does not show any very great difference. The propelling machinery in the steamship is of the usual 3-crank triple-expansion type with cylinders 27, 45 and 75 by 48 in., and three boilers, 14 ft. 6 in. by 11 ft. 6 in., fitted with Howden's forced draught. The actual results from a number of different voyages show an average of 2,400 I. H. P., and a consumption of 1.6 lb. per H. P. per hour for all purposes.

The propelling machinery of the Diesel ship is of the single-acting 2-stroke cycle type, designed to develop 2,150 B. H. P. in ordinary service at sea, at about 115 revolutions. The propeller performance at 115 revolutions should be satisfactory, and it was considered unnecessary to make the form of the Diesel vessel any finer than that of the steamship, so that the comparison between the two is as close as it is possible to make it.

The 2-stroke cycle engine was adopted partly in deference to Dr. Diesel's opinion as expressed on several occasions, and partly because the balance of advantages seems to be with it rather than with the 4-stroke cycle engine. It is claimed on behalf of the 4-stroke cycle that the fuel consumption is considerably (according to some authorities 10 per cent) lower than that of the 2-stroke cycle engine. This appears to be due: first, to a thermal superiority in the 4-stroke cycle, perhaps due to the greater effective length in the cylinder, and the longer scavenging period; and, sec-

ondly, to the mechanical superiority which arises from the absence of the scavenging pump. It seems doubtful, however, whether these gains can amount to 10 per cent if balanced against the loss due to the idle strokes in the 4-stroke cycle engine, and the general consensus of opinion, so far as the writer is aware, seems to be that the 2-stroke cycle type is the better adapted for marine propulsion purposes. The weight is about 12 to 15 per cent, and the cost about 10 to 12 per cent less than that of the 4-stroke cycle engine.

The estimate of working shows how important it is to keep the first cost of the vessels as low as possible. The cost of the vessels which have been

taken for the purposes of this estimate are not to be regarded as definite quotations, but are calculated on precisely the same basis and are therefore comparable. The influence of cost and weight of machinery on the earning power of cargo vessels is considerable and in choosing between the 2-and 4-stroke cycle it deserves special attention, as a point is soon reached when the saving due to the lower consumption of the 4-stroke cycle engine is counterbalanced by the capital charges on the higher cost and the loss on freight-earning cargo shut out by the extra weight of the engine.

This critical point depends on the length of the voyage, or the distance between fuel stations, and the cost

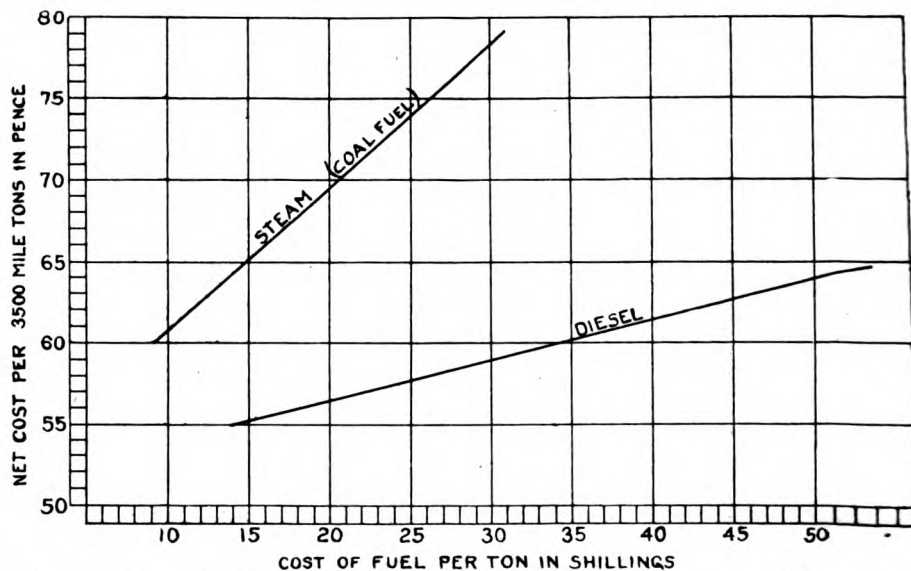
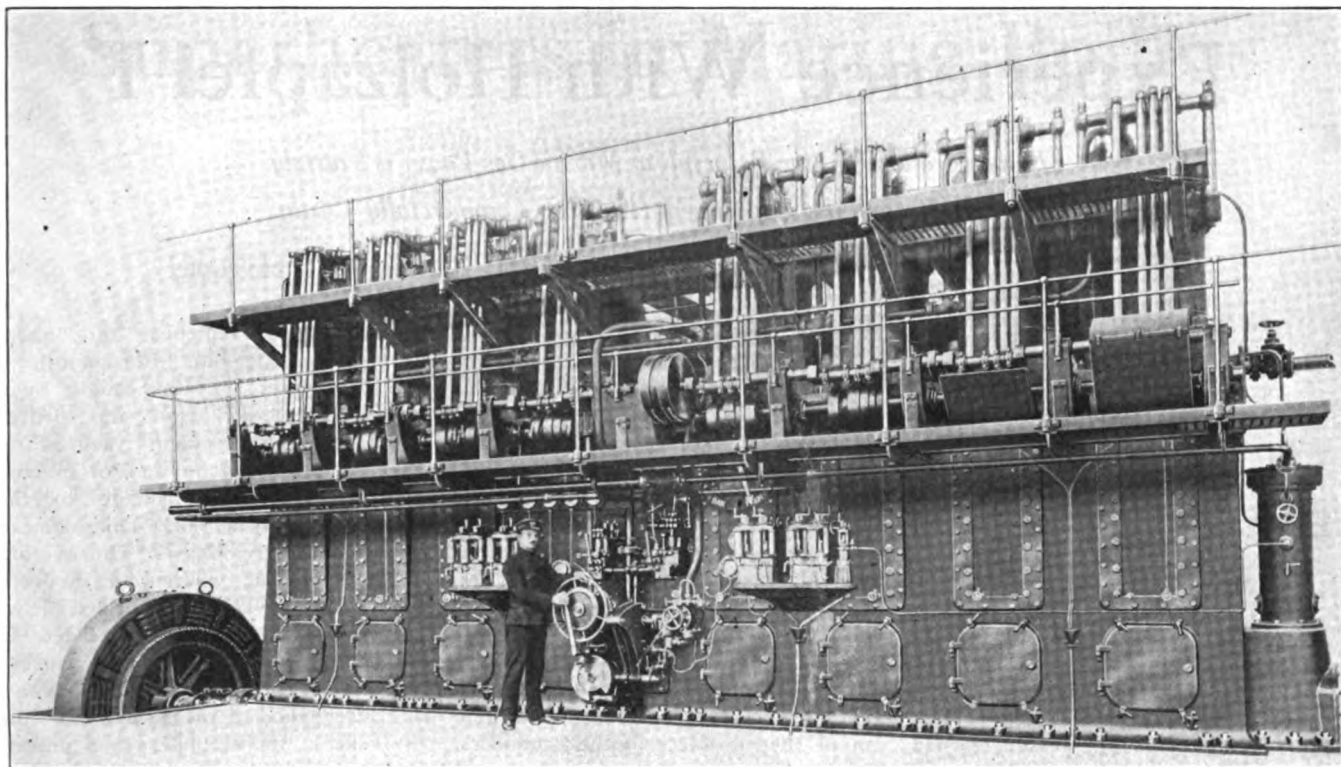


FIG. 3—COMPARATIVE COSTS OF WORKING STEAM AND DIESEL-PROPELLED VESSELS AT FUEL RATES VARYING FROM 10 TO 50 SHILLINGS



ONE OF THE MAIN ENGINES OF THE SELANDIA

For description see April MARINE REVIEW

of the fuel oil. In the vessels under consideration it appears to occur at about 3,500 miles, when the cost of the oil is 20s per ton, and the limiting length of voyage decreases slightly as the cost of oil rises.

Fig. 3 is a diagram showing the comparative cost of working the two type vessels with fuel at prices ranging from 10s to 50s per ton. The ordinates are taken for a number of voyage estimates of which the model is shown in detail in Table I. The lower curve shows the cost per 3,500 mile tons of working the Diesel ship at a consumption of 0.55 lb. per B. H. P. and per hour; the upper the corresponding cost for the steamship at a consumption of 1.6 lb. per I. H. P. per hour. The comparison shows that with coal at 15s per ton

TABLE II.—LIST OF CREW.

	Coal Fuel.		Diesel Oil Engines.	
	Wages.	Provisions per day.	Wages.	Provisions per day.
Captain	24	2 6	24	2 6
First Officer	18	2 6	18	2 6
Second Officer	16	2 6	16	2 6
Third Officer	14	2 6	14	2 6
Carpenter	7	1 6	7	1 6
Steward	7	1 6	7	1 6
Second Steward	6	1 6	6	1 6
Cook	6	1 6	6	1 6
Boatswain	6	1 6	6	1 6
Storekeeper	6	1 6	6	1 6
Ten A. B.'s at £5 13s	55	1 6	55	1 6
Chief Engineer	22	2 6	22	2 6
Second Engineer	16	2 6	16	2 6
Third Engineer	12	2 6	12	2 6
Fourth Engineer	10	2 6	10	2 6
Twelve firemen at £6	72	1 6	36	1 6
One donkeyman	7	1 6	7	1 6
(37 men) per month	£304	£100	£268	£75
Wages	£304		£268	
Provisions	100		84	
Per month	£404		£352	

the cost of oil in the Diesel ship must not exceed 50s per ton, as the eco-

nomical limit within which the Diesel ship shows to advantage

TABLE I.—APPROXIMATE ESTIMATE OF THE COMPARATIVE COSTS OF WORKING STEAM AND OIL-PROPELLED CARGO VESSELS.

Capital	Oil Engine. £78,000.		Steam Engine. £63,000.	
	Per Voyage.	Per Month.	Per Voyage.	Per Month.
Insurance	—	490	—	370
Fuel (oil at 40s, coal at 15s)	360	—	445	—
Wages and provisions	—	350	—	410
Wear and tear	—	110	—	130
Deck and engine-room stores	—	110	—	100
Port charges at 5s ton	755	—	735	—
	1,115	1,360	1,180	910
16 voyages	17,840	—	18,880	—
12 voyages	12,720	—	11,760	—
	30,560	—	30,640	—
Five per cent depreciation	3,900	—	3,150	—
Management	500	—	500	—
	£34,960	—	£34,290	—
Tons freight-earning cargo carried	16 × 8,530 = 136,480	—	16 × 7,880 = 126,080	—
	34,960 × 240 = 8,390,400d.	—	34,290 × 240 = 8,229,600	—
	136,480 = 61.4d.	—	126,080 = 65.2d.	—

The high cost of Diesel engines and the important influence of capital charges on the earning power of cargo vessels largely affect the question of driving the auxiliary machinery, and it seems very doubtful whether electric power or compressed air can ever be used for this purpose without a considerable sacrifice both in first cost and future earnings. In the type ship steam has been adopted supplied by two oil-fired boilers one for use at sea the other in port. This question deserves very careful consideration and it is to be hoped that some light may be thrown upon it by engineers who are studying the subject.

Experience With Holzapfel I

Demonstrating that the Principle of Marine Gas Power is Entirely Feasible Though the Experiment Has Been Commercially Costly.

By A. C. Holzapfel

SINCE the Holzapfel I, the first sea-going cargo vessel driven by gas engines, was built, almost a year has elapsed, and the work which she has performed during that time has scarcely realized my anticipations. I did not fully appreciate at the time of her construction the difficulties of adopting, for use on ship board, a new type of power hitherto only used for land purposes.

Difficulties of adaptation for use in a small sea-going vessel, where the conditions are accentuated during rough weather, will be appreciated. On the other hand, the lesson learned is the more reliable, for when a coast-er trading in winter time on the rough coasts of Great Britain and the Channel has passed through heavy weather, and her power installation has successfully withstood the strain, it may confidently be expected that vessels similarly fitted will stand any weather in practically any seas.

Collision With the Whinfield

An unfortunate collision with the Whinfield which took place on her loaded trial in the Tyne was a bad start for the vessel, and it was followed, after her repairs had been executed, by difficulties with a pump attached to the transformer, which necessitated the vessel putting into Scarborough for repairs. After these were executed and the vessel started again, it was found that, owing to the collision the engines and transformer had slightly shifted and the bearings consequently got heated, which necessitated the vessel putting back once more to Scarborough. After the engines had been reset, she again started for London, but had not proceeded far when some water got into the pipes leading from the producers to the scrubbers, thus shutting off the gas. As a result, gas pressure arose in the producers causing burning gas to come into the engine room. This phenomenon was new to those on board, although it is not unusual in connection with gas plant, and the result was that they shut the engine room down and signalled for assistance. The vessel was consequently towed into the Tyne by the steamship Bow, of Lon-

don, at considerable expense, nearly half of which was borne by the owners. In the Tyne, various alterations were made to her machinery and the ship then started for London, where she arrived in due course and discharged her cargo. She next loaded a cargo of scrap iron for Llanelly, and made the run to that port without incident, discharging her cargo and loading a cargo of lime back to London. On her return voyage, the gas between the producers and engine was again shut off by water in the pipes and burning gas came a second time out of the air inlets in the producers. This time, however, those on board were used to the phenomenon, and, after clearing the pipes, restarted the ship for London under her own power, where she duly arrived and discharged her cargo. On this trip, however, it was found that the bearing between the engine and the transformer had got heated, and as a consequence a careful examination of the transformer foundations was made in London, when it was discovered that, owing to the collision in the Tyne, the transformer had also been shifted on its bed.

Alterations in the Vessel

The Vulcan company, of Stettin, then sent two experienced workmen to remount the transformer, whereupon the vessel was started again on a voyage from London to Cork. She did this run without incident, as also the homeward run from Cork to Newhaven. Thence she proceeded in ballast to Guernsey and loaded a cargo of granite for London, and from London she loaded again for the Tyne. Here it was decided to put two masts into her and also to shift the after winch and to fit longer booms than those originally fitted, in order to enable her to discharge her cargo when lying alongside a high quay at low water. A new propeller was also fitted, as the original propeller in the opinion of the owners had too much pitch and surface. After these alterations, the vessel proceeded to Seaham to load for Morlaix, on the northwest coast of France. During this run she met with very bad weather, and put into

Portsmouth to replenish her bunker coal. When leaving Portsmouth a few days later she was caught by a strong tide and wind and drifted against the government yacht Firequeen, lying at anchor in Portsmouth, doing considerable damage to the Firequeen and herself. This damage was repaired by Messrs. Thornycroft, in Southampton, whereupon she continued her voyage to Morlaix, delivered her cargo, and proceeded in ballast to Guernsey. On this trip she again met with severe weather, and, in consequence of the severe buffeting the coke in the scrubbers was pulverized to such an extent as to close the overflow pipes. In consequence of this the water in the scrubbers rose and shut off the gas supply, till finally it ran over into the producers, on entering which something in the nature of an explosion took place, and large quantities of steam filled the engine room. During this time she was drifting about the dangerous water of the Channel islands, and the captain signalled for assistance. She was then towed into Guernsey, where she loaded her cargo and proceeded to Weymouth; after discharging her cargo at that port, she proceeded to Poole to lie up for alterations and repairs.

Coke Not Suitable in Sea-Going Vessels

It has been found that coke is not suitable in the cooling towers or scrubbers of sea-going vessels, and it has consequently been replaced by earthenware pipes of special design, which are closely packed into position and of sufficient strength to withstand the shocks and buffetings of a small vessel in a seaway. The whole of the machinery has been overhauled, and a new type of ignition fitted by Messrs. Lodge Bros., of Birmingham, and the vessel is now resuming her employment.

The experiences which she has passed through have shown many defects in her machinery and particularly in the gas plant, all of which have been remedied. Her performances have shown that the principle of marine gas power is entirely feasible and the economy as regards coal consumption unquestioned.

Superheaters in Marine Boilers

Results of Experiments With a Water Tube Boiler With Special Reference to Superheating

By Harold E. Yarrow

THE author's firm having recently tried some important experiments with a water-tube boiler, it was thought that the results would be of interest to the institution, and he therefore ventures to bring them before this meeting. Being convinced that superheating is one of the directions in which advances in marine engineering will be made, a water-tube boiler was constructed which was fitted with a special form of superheater. The objections which have hitherto been raised to superheating for marine work are:

1. Owing to the dryness of the steam, oil for the internal lubrication in reciprocating engines becomes a necessity, and the oil, finding its way into the boiler, leads to trouble.

2. The probability of burning the superheater when the passage of the steam through it is suddenly reduced or stopped.

By the introduction of turbines the difficulty of lubrication does not occur and with regard to burning the superheater tubes, the arrangement adopted by the author's firm avoids this risk.

The boiler with which these tests were made was of the Yarrow type, and was fitted up in an experimental shop, which is equipped with the nec-

tions, very accurate results were obtained, which would not have been possible with coal, in which case irregularity of stoking and other sources of discrepancy occur. During the experiments careful records were taken of the oil consumed, the water evap-

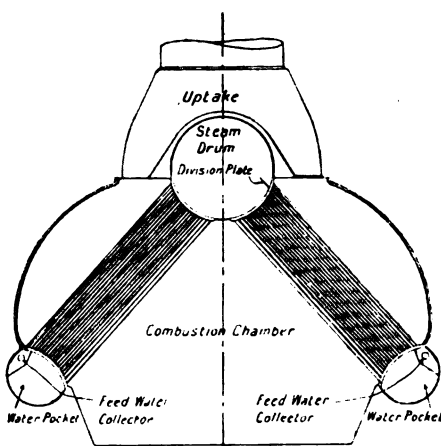


FIG. 2

orated, steam pressure, temperature of the super-heated steam, and the temperature of the gases at various points during their passage past the boiler-tubes.

Superheating in Land Installations

As is well known, superheating is very largely adopted in land installations, and in locomotives it is being rapidly introduced. From information kindly given by the locomotive superintendents of the main railway lines in this country, it appears that the economy realized in locomotives due to superheating averages fully 20 per cent in fuel consumption, and rather more in water consumption. It may perhaps surprise many marine engineers to know that on the Great Western railway alone no fewer than 500 locomotives are now running fitted with superheaters. Taking the average of several land turbine installations, there is found by superheating to 100 degrees Fahr. to be a saving in consumption of fuel of from 8 to 10 per cent, and in steam consumption from 10 to 12 per cent. The reduction in steam consumption is specially important for marine work, as it enables a reduction to be made in the size and weight of the condensers,

air pumps, circulating pumps and feed pumps, and probably of the distilling plant. Independent of gain directly due to superheating, the risk of water passing into the turbine from any cause whatever is reduced, and the fear of damage in consequence of water causing the stripping or cutting of the blades is diminished, and any additional cost of upkeep of the superheater will doubtless be fully balanced by the diminished risk of injury to the turbine blades by the action of water when using saturated steam.

Turning now to the design of the boiler and superheater with which the various experiments were carried out, and referring to Fig. 1, which shows a cross section of the boiler, it will be seen that it consists of a top steam collector, as usual, and two lower water pockets. On the left hand side the superheater is shown, and it will be observed that on this side of the boiler there are fewer rows of generator tubes than on the other side, where there is no superheater, it being thought desirable that the total heating surface and the resistance to the gases on both sides of the boiler should be approximately the same. The total heating surface of the boiler

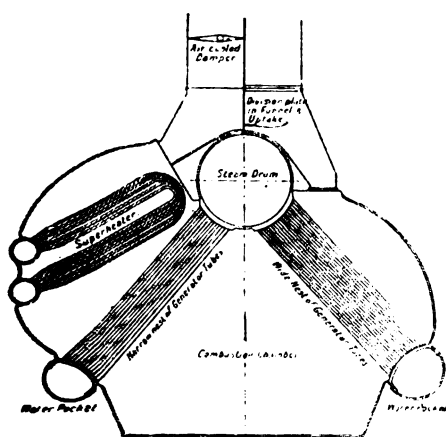


FIG. 1

essary plant for making very complete tests. Throughout the experiments oil-fuel only was used; and as it is possible with oil to maintain steady and uniform working condi-

*Paper read before the Institution of Naval Architects, March 28, 1912.

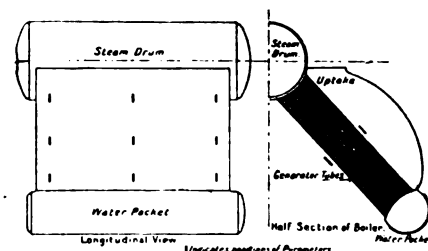


FIG. 3

was 6,700 sq. ft., of which 1,265 sq. ft. consisted of superheating surface; the total heating surface on the superheater side of the boiler was 3,453 sq. ft., and on the other side 3,247 sq. ft.

The superheater consisted of a number of U tubes expanded into two longitudinal collectors, small doors being fitted so that access to the tubes could be obtained when required. The leading feature of the arrangement is that the superheater is placed on one side of the boiler only, and a damper is fitted in the up-take on the same side, as shown on the diagram. If this damper is closed, the whole of

the gases are deflected towards the opposite side of the boiler, and no heated gases pass the superheater, the object being that if the main engines should be suddenly eased or stopped, or when raising steam, the superheater may be shut off, so as to prevent the tubes being damaged, or the steam being superheated to an excessive extent, owing to there not being sufficient circulation of steam. In this way one objection to the introduction of superheating for marine installations is overcome.

Advantage of the Arrangement

A further advantage of this arrangement is that when the consumption of steam is suddenly reduced or stopped, not only does the damper prevent the superheater tubes from being burnt, but it also greatly diminishes the output of the boiler at the time when a reduced supply of steam is wanted, because only about one-half of the heating surface comes into contact with the hot gases. To avoid the possibility of the damper getting distorted through overheating, it is provided with a hollow spindle, to which air is admitted, and which passes from thence between the two plates of the damper, escaping at the edges, and thus keeping the damper cool. This arrangement of damper has proved thoroughly successful under the most trying conditions.

In order to carefully measure the temperatures of the superheated steam, and of the gases, a complete installation of thermometers and pyrometers was fitted to the boiler, and the author has to thank the director of the National Physical Laboratory, Dr. Glazebrook, and Dr. Harker for the assistance which they kindly afforded in the selection of the most reliable instruments for this purpose. Turning to Table A, giving particulars of a series of trials with the damper open, it will be seen that the results are given for six rates of evaporation. It will be observed that at the maximum rate of evaporation—namely, when burning 1.237 lb. of oil per sq. ft. of heating surface per hour—the degree of superheat was 93 degrees Fahr. Corresponding figures are given at the lower rates of evaporation.

Passing now to similar trials with the damper closed, and for which the heating surface of the boiler is assumed to be that of the large nest of generator tubes only, as all the gases have to pass on that side of the boiler, the results of this series are shown on Table B.

As one of the objects of the marine engineer is to obtain more and more

steam from a given weight of boiler, it was thought it would give useful information to make tests burning oil fuel at a rate of consumption considerably greater than has hitherto been the custom, to ascertain if the boiler

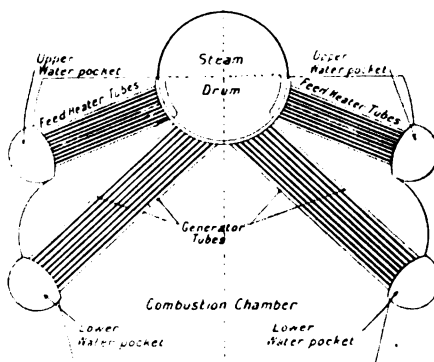


FIG. 4

would, under such conditions, show any defects. It will be seen from Table B, that at the highest rates of evaporation nearly 2 lbs. of oil per sq. ft. of heating surface per hour were being consumed, if we disregard the heating surface on the superheater side of the boiler. Thus the surface on the opposite side of the superheater was subject to the heating effect of all the gases plus half the radiation. Every part of the boiler withstood the severe test, and trials burning this quantity of oil were made on several occasions.

Trials of Destroyer Archer

The results of other experiments indicate that in a properly-designed boiler of the type under discussion it is possible to burn, without injury to the boiler, 2 lbs. of oil per sq. ft. of heating surface per hour.

Since these experiments were car-

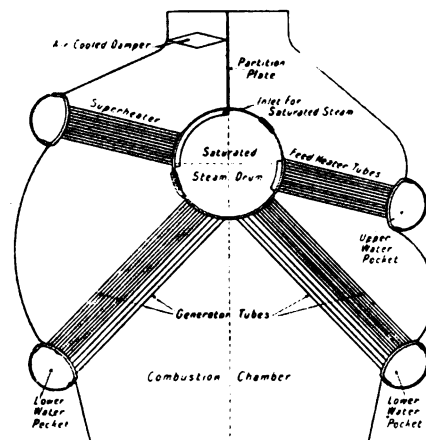


FIG. 5

ried out the official trials have taken place with one of the destroyers built by Yarrow & Co., H. M. S. Archer, in which boilers fitted with superheaters were provided. The result of these trials showed that the gain expected

was fully realized, and on the full-speed trial the degree of superheat at the turbines was 94 degrees Fahr.; the shaft horsepower developed was slightly over 18,500, which compares with about 17,000, which is the shaft horsepower the builders expected had the boilers been of the usual type. The mean speed obtained on the six runs on the measured mile at Skelmorlie was 30.9 knots, and the mean speed for eight hours 30.3 knots, the contract speed being 28 knots.

Covering High Pressure Cylinder

One point to which Mr. Charles Merz (to whom the author is greatly indebted for much valuable information) has drawn attention is the necessity, with superheated steam, of efficiently covering the high pressure portions of the turbine cylinder with non-conducting material, because the metal on the inside of the cylinder in contact with the steam becomes hotter than that on the outside, especially at the edges of flanges and ribs. The inside tends to expand, and this expansion is resisted by the colder metal on the outside; consequently, if the temperature difference is great enough, the metal will be distorted and perhaps strained beyond its elastic limit. For this reason, the design of the ribs should be carefully considered, the thickness of metal throughout the structure being kept as uniform as possible.

These experiments have also been the means of pointing out another important improvement in the Yarrow boiler, and Fig. 2 has been prepared, which illustrates the ordinary type of boiler without superheater, from which it will be seen that the last two rows of tubes farthest from the fire are partitioned off for the feed water to ascend. When working the boiler at high rates of evaporation, it was found that notwithstanding all possible precautions, even with turned rivets and carefully reamed holes, it was impossible to prevent the riveted seam of the water pockets from leaking. It was found the pocket was sometimes hot and sometimes cool; indeed, in places sufficiently cool to be able to bear one's hand on it. These trials were frequently repeated with the same result, and ultimately the cause was found out. The fact was that the suction down the tubes which were in close proximity to the feed-heating tubes was so great that the cool feed water which had passed up the feed-heating tubes was instantly drawn down into the water pocket without having had time to mix with the hotter water in the upper chamber, as indicated by the arrow in Fig. 2. This action took

TABLE A.—TRIALS WITH DAMPER OPEN.

From and at 212 deg., Fahr.		Temperature of uptake in deg. Fahr.	
Steam Pressure, Pounds per sq. in.	Superheat in Deg. Fahr.	Air Pressure in Inches of Water.	Pounds of Water Evaporated per Hour.
242.0	93.5	5.0	94,659
243.0	93.0	3.16	76,021
243.7	82.5	2.44	68,387
242.8	61.1	1.7	46,041
241.8	31.0	0.998	20,059
242.2	20.75	0.625	8,478
Pounds of Oil Fuel Burnt per Hour.	Water per Pound of Oil.	Water per Sq. Ft. of Heating Surface.	Pounds of Oil Fuel Burnt per Sq. Ft. of Heating Surface per Hour.
8286	14.6	18.0	1,237
6454	15.0	14.4	0.9635
5695	15.2	12.9	0.850
3630	15.9	8.6	0.542
1540	16.1	3.7	0.230
649	16.1	1.55	0.096
Temperature of Feed- Water in Deg. Fahr.	Temperature between Small Nest of Gen- erator Tubes and Superheater in Deg. Fahr.	Above Super- Heater.	Above Large Nest of Gene- rator Tubes.
58.0	1121	828	887
63.5	926	698	727
63.5	903	685	688
64.0	647	536	551
62.2	481	432	448
63.5	465	409	416
Heating surface Large nest of generator tubes..... 3247 sq. ft.		6700 sq. ft. total.	
Small nest of generator tubes..... 2188 sq. ft.			
Superheater..... 1265 sq. ft.			

On these trials the heating surface is taken as the total heating surface of 6700 sq. ft.

place intermittently, and the water pockets locally changed their temperature, one portion of the water pocket being one minute hot, and another minute comparatively cool, dependent upon the working of the feed pump. The strain thus thrown on the metal of the water pockets by this short-circuiting of the feed was evidently severe, and resulted in the leakage of the seams. Having discovered the cause of the trouble, it was not difficult to find a remedy. It was found that by simply placing a longitudinal partition plate in the upper chamber, so as to avoid the short-circuiting of the feed, all difficulties disappeared. This plate is shown on the right hand side of the diagram only, but in practice would, of course, be fitted on both sides. The same trouble has before been met with, especially abroad, but the true cause was never suspected; it was generally put down to inferior workmanship. Even when no trouble is experienced it is evident that serious and undesirable strains must at times be taking place, which may in the end lead to the failure of the metal, due to constant fatigue. By the fitting of this partition plate, however, all such strains are eliminated.

Temperature of Gases

Fig. 3 has been prepared to show the positions of the pyrometers. Table C, Fig. 8, shows the temperature of the gases at various points in the boiler. The vertical lines correspond to the position of the pyrometers as shown. The upper curve indicates the gas temperatures at a rate of evaporation of 16 lb. of water per sq. ft. of heating surface, and the lower curve represents the gas temperatures at a rate of evaporation of slightly over 3 lb. per sq. ft. of heating surface. The horizontal lines represent temperatures and the line B C represents the temperature of the steam at 200 lb. pressure, and the line E F the tem-

perature of the air pump discharge taken at 78 degrees Fahr.

It will be observed that a very great drop in temperature takes place during the passage of the gases through the first rows of tubes, showing the large proportion of heat that is taken

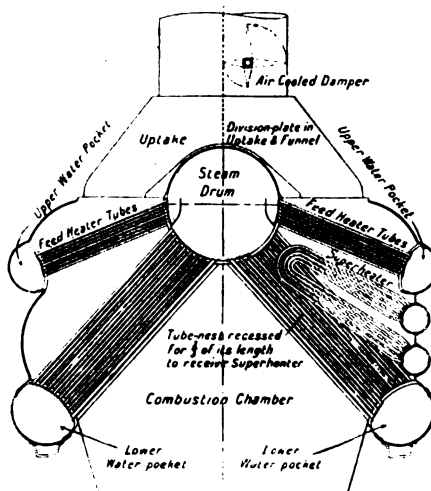


FIG. 6

out of the gases by these tubes. Also, it will be observed that there is a sudden drop in the temperature at A and A'—that is, where the gases pass through the last rows of tubes. This is due to the fact that the cold feed water (which enters a portion of the

water pocket) abstracts a greater amount of heat from the gases in ascending the two outside rows of tubes than would be the case if these tubes were full of water at the temperature of the steam.

Referring to Table C, given in diagram form, it will be seen that the temperature of the gases at the point A'—i. e., just prior to the gases passing the feed-heating tubes—is about 550 degrees Fahr., and the temperature of the steam at 200 lbs. pressure is 388 degrees Fahr., a difference of only 162 degrees, whereas the temperature of the air-pump discharge of 78 degrees Fahr., gives a difference of 472 degrees. This clearly shows the gain due to this system of feed-heating, and the desirability of extending it, which can be effected by having separate water-collectors and feed-heating tubes apart from the main water collectors and main generator tubes—i. e., there would be two water collectors on each side of the boiler, the tubes connected to the top one acting as a feed heater, and such a design of boiler is shown in Fig. 4.

Supplementary Advantages

It should also be pointed out that there is a supplementary and an important advantage in this feed-heating—namely, that any grease or sediment that comes over with the feed is deposited in these tubes, which are not subject to fierce heat, rather than in those near the fire, which are exposed to the intense radiation of the furnace, and thus the life of the boiler is prolonged. With the introduction of oil fuel some such arrangement is the more necessary, because it has been found that the oil heaters leak, with the result that oil mixes with the steam and passes ultimately into the boiler.

As the author thought it would interest the meeting to indicate some of the arrangements for superheating and feed-heating which may be adopted with a view to still further improving

TABLE B.—TRIALS WITH DAMPER SHUT.

From and at 212 deg. Fahr.	
Steam Pressure, Pounds per Sq. In.	Air Pressure, Inches of Water.
242.0	4.85
242.25	3.97
242.4	2.491
242.5	1.46
Pounds of Water Evaporated per Hour.	Pounds of Oil Fuel Burnt per Hour.
68,648	6287
57,693	5065
44,050	3504
31,481	2473
Water per Lb. of Oil.	Water per Sq. Ft. of Heating Surface.
13.25	25.66
13.84	21.6
15.3	16.5
15.4	11.75
Lbs. of Oil Fuel Burnt per Sq. Ft. of Heat- ing Surface per Hour.	Temperature of Feed- Water in Deg. Fahr.
1.936	61.0
1.56	60.0
1.09	60.3
0.76	63.5
Heating surface Large nest of generator tubes..... 3247 sq. ft.	
Small nest of generator tubes..... 2188 sq. ft.	
Superheater..... 1265 sq. ft.	
6700 sq. ft. total.	

On these trials the heating surface of boiler is taken as heating surface of large nest of generator tubes = 3247 sq. ft.

the results in connection with such a boiler as the one being dealt with, he begs your reference to three illustrations.

Fig. 5, it will be seen, shows the superheating tubes united to the steam drum, and to a steam receiver sufficiently large for a man to enter, the tubes being expanded at both

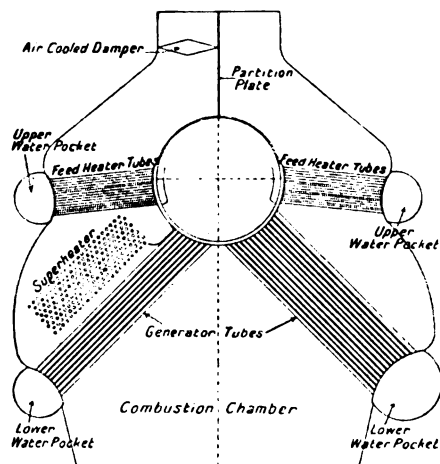


FIG. 7

ends. In this arrangement all the tubes are straight, a condition much appreciated by many authorities; and also there is an additional advantage by this system, as the superheating tubes on the one side of the boiler and the feed heating tubes on the other side of the boiler are of such a length that they can be withdrawn and replaced from inside the steam drum.

Fig. 6 shows a set of U-shaped tubes placed between the generator tubes and the nest of feed heating tubes, the nest of generator tubes being recessed for about two-thirds of its length to receive the superheater. The ends of the superheater tubes are expanded into two longitudinal steam receivers. This arrangement will probably be the most efficient for a given quantity of heating surface.

Straight Tubes

Fig. 7 shows the superheater tubes placed at right angles to the generator tubes. This arrangement has the advantage that all the tubes are straight. It should be noted that the arrangement of running the tubes at right angles to the generator tubes has already been adopted in boilers of certain warships constructed by Messrs. John Brown, and also by Messrs. Yarrow, with the exception that a superheater was fitted on both sides of the boiler, and was, therefore, not under the same control as in the case of the superheater fitted only on one side in conjunction with a damper.

It is proposed in some cases to

have an additional damper on the opposite side to the superheater, the two dampers being arranged so that either can be opened, or both open, but under no condition can both be closed. This enables the superheater side of the boiler to be used to a greater or less extent as desired. When cruising at a slow speed this arrangement may possibly lead to a more economical result than if both sides of the boiler are equally free for the passage of the hot gases.

Gain in Economy

Judging by the best practice in land installations, 100 degrees Fahr. superheat is by no means the limit that can be adopted with advantage. It is reasonable to suppose that the requisite condition to be desired is that the steam should remain in gaseous form as far as possible during its passage through the turbine, because any condensation that takes place must diminish the energy given out by the steam to the blades of the turbine, also if the steam remains in gaseous form the steam friction is reduced.

The author submits, from the results of the accumulated experience of others, and from his own experiments, that there will be a certain gain by the use of superheated steam of from 8 to 10 per cent in fuel economy when using 100 degrees Fahr. of superheat, and from 11 to 13 per cent gain when using 150 degrees Fahr. of superheat in combination with a pressure of 200 lb. per sq. in. Also a further gain in

the remaining heat should be absorbed which would otherwise be lost. Although the experiments were made with an oil-burning boiler, the various arrangements as shown in the diagrams would be equally suitable if coal were used, and there is no reason to suppose that similar advantages could not be obtained.

With regard to the relative weight of boilers with and without superheaters, provided the total heating surface were the same, there would be no appreciable difference. If, however, the complete machinery installation is taken into account, there would probably be a small saving in weight in the case of the installation with superheated steam. The author therefore submits that in the propelling machinery of warships improved results can be obtained by superheating, without increased weight, cost, space, or upkeep, and a further extension of feed-heating by the waste gases.

In conclusion, the author thanks those gentlemen who have assisted in carrying out the experiments he has had the privilege of describing, and also those who have assisted in the preparation of this paper, especially his father, A. F. Yarrow, Mr. Crush, Mr. Marriner, Mr. Cotton and Mr. Stone.

Largest Oil-Engined Vessel

What will be the largest oil-engined ship so far ordered will also be the largest oil carrier. This vessel has been ordered by the German-American Petroleum Co., and will be built at the Krupp yard at Keil, Germany. The vessel will be built on the Isherwood system and will be 525 ft. long, 66 ft. 3 in. beam and 41 ft. 3 in. deep. Her propelling power will consist of two single-acting, two-cycle Diesel engines, aggregating about 3,500 B. H. P. at 125 revolutions. Her expected speed is 10 knots. Another large tank steamer is being built for the Antwerp Industrial Co. by the Netherland Ship Building Co., to be 375 ft. long, 51 ft. beam and 23 ft. draught, displacing 9,400 tons. She will have two oil engines of a total brake horsepower of 2,200 at 140 revolutions, of the four-stroke, reversing type, driving twin screws.

John H. Dialogue & Son, Camden, N. J., have been awarded contract by the Moran Towing & Transportation Co. for a steel tug to be 115 ft. long for service in New York harbor.

The Newport News Ship Building & Dry Dock Co., Newport News, is converting eight vessels of the Southern Pacific Railway Co. into oil burners.

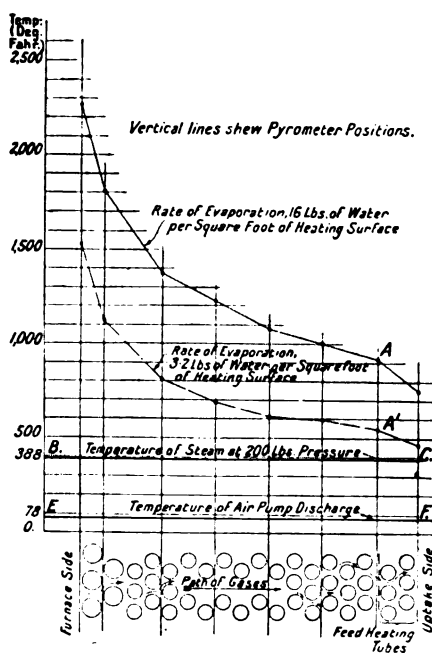


TABLE C, FIG. 8

fuel economy can be obtained by an efficient system of heating the feed from the gases after they have passed the generator tubes, so that some of

Diesel Engines in Whalers

Two Vessels for Service in the Antarctic—Equipped With Polar-Diesel Engines of 200 H. P.—Large Saving in Fuel Cost

By J. Rendell Wilson

OWING to the very high manufacturing costs of marine Diesel oil engines, brought about by the expensive plant, and specially skilled labor, required for the very accurate machining, which is essential, it is hardly likely that many will be constructed in sizes under 100 H. P. For residue oil engines up to this power, it is generally conceded that the semi-Diesel type will largely be adopted. The combustion in the Diesel engine is entirely due to the heat generated by high compression in the cylinder, which is usually between 500 and 800 lbs. per sq. in. In the case of the semi-Diesel, combustion, being assisted by a hot-pot or vaporizer, is generally between 150 lbs. and 250 lbs. per sq. in.; while with both types of engines electrical ignition devices are absolutely dispensed with. Although accurate workmanship is required with the latter class, the machining of principal parts does not have to be carried to so fine a pitch, thus the production cost is less. With the machining of Diesels, any important part that is three-thousandths of an inch out is scrapped.

Large Market for Diesel Engines

There is undoubtedly a large opening for Diesel engines of about 200 H. P., owing to the enormous saving in working expenses over coal or gasoline, despite the heavy initial cost. Several yachts and naval craft and many commercial vessels are now being fitted with Diesels in Great Britain, while on the continent nearly a hundred ships, ranging from little tugs to 6,000-ton vessels, are actually in service, and as many more under construction. Only about six British-built Diesel ships are now afloat and of these five have continental engines installed, not taking into consideration of course, naval sub-marines.

Two of the most recent small Diesel craft to be built in England are the whalers G. D. I. and C. O. J., sister boats owned by the Southern Whaling & Sealing Co., of North

Shields, designed for whaling in the Antarctic, in which waters, curiously enough, is Amundsen's 180-H. P., Diesel-engined exploration ship, Fram. I am enabled to give illustrations of G. D. I. and her engine room. She is 92 ft. long by 18 ft. beam, with 6 ft.



THE 200-H. P. DIESEL WHALER G. D. I., BUILT IN ENGLAND FOR SERVICE IN THE ANTARCTIC—HER DIMENSIONS ARE 92 X 18 FEET AND HER FUEL BILL BURNING RESIDUE OIL IS ONLY 40 CENTS AN HOUR

10 in. draught, and is classed to the British Corporation Registry. She is a single-screw boat, and is driven by a Polar-Diesel engine of 200 H. P., constructed by the Aktiebolaget Diesels Motorer, of Stockholm, Sweden.

Description of the Engine

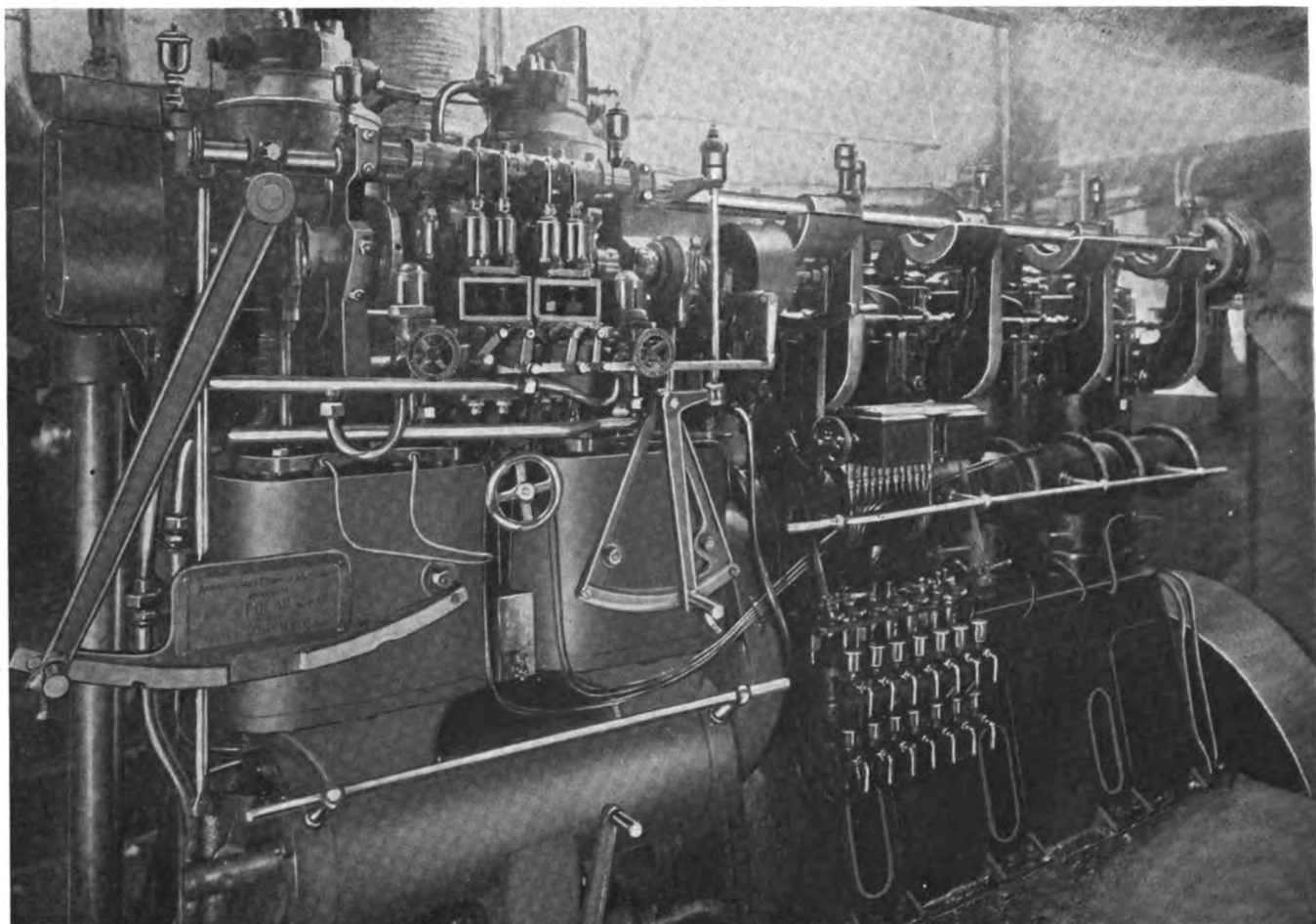
This engine is of the two-stroke, direct reversible, single-acting class, and has four working and two maneuvering cylinders, while 200 B. H. P. is developed at 280 R. P. M., although on test 222 H. P. was attained with 12 more revolutions, on a net load of 152 kilograms. Owing to the starting and reversing of big engines being by compressed air, the sudden changes in the temperature in the cylinders, caused by the too cool an air blast, is apt to have ill effect on the castings, therefore the makers of this engine provide two extra cylinders, which are only used for starting and reversing and air compressing, so that each of the four working cylinders develops some 50 H. P. This system also eliminates the necessity of having starting and scavenging valves in the heads of the working cylinders. When the engine is fully in action, the two maneuvering cylinders are used only for compressing air. With

further regard to the maneuvering cylinders, which can be seen on the left-hand side of the illustration of G. D. I.'s engine room, the forward cylinder contains a single-stage compressor, formed by a stepped extension of the piston, that keeps a steel storage bottle charged with air to about 150 lbs. per sq. in., this air being used for starting and reversing, delivery to the pistons being by a reducing valve. The second maneuvering cylinder is double-acting, and the upper part of the piston is extended and has two steps, forming a two-stage compressor, so that there are three diameters to this piston. Air for starting purpose is supplied to either side of the pistons according to its position when the engine is at rest, through a piston-type valve,

the latter being operated by an eccentric off the overhead cam shaft. Air is also supplied for the same purpose to the piston of the forward maneuvering cylinder in the same manner. The low-stage compressor in the after maneuvering cylinder supplies air at 5 lbs. per sq. in. to the four working cylinders, just at the end of the firing stroke, for scavenging purposes; while the high-stage compressor maintains an air bottle charged to 900 lbs. per sq. in., this supply being used for fuel injection.

The Working Cylinders

Let us now turn to the working cylinders. There is only one mechanical valve to each, namely, the fuel injection valve, which is operated by a rocker mounted on a fulcrum, actuated in turn by the overhead cam shaft. The latter runs the entire length of the engine and is driven by bevel gearing and a vertical shaft at the forward end off the crank shaft. All cranks, including those of the maneuvering cylinders, are set at 90 degrees, so there can be no dead-center. To each cylinder there is a separate fuel pump, which supplies the exact quantity of oil necessary for each stroke. The force of



ENGINE ROOM OF THE DIESEL WHALER G. D. I., SHOWING THE 200-H. P. POLAR MARINE ENGINE, CONSTRUCTED BY THE AKTIEROLAGET DIESELS MOTORER, OF STOCKHOLM, SWEDEN

the pump injects this into a small chamber having a non-return valve, and the air valve then opens at the top of the compression stroke and blows the fuel into the cylinder at 900 lbs. per sq. in. This high pressure is necessary, owing to the cylinder compression being about 700 lbs. per sq. in. The compression induces an enormous heat, sufficient to ignite the heaviest of residue oils.

Lubricating and fuel consumption are both extremely low, that of the fuel being under $\frac{1}{2}$ lb. per B. H. P. per hour. Residue oil in most districts of the United States being only 3 cents per gallon, a 200-H. P. engine of this type would cost but 40 cents per hour for fuel; while a gasoline motor of similar power, would cost \$3 per hour, taking gasoline at 12 cents per gallon. This means a very big difference in a year's service. For 300 days, running 12 hours per diem, the fuel bill of a Diesel-engined vessel would be but \$480, while a sister ship, fitted with gasoline motors and running the same hours, would have to meet a fuel bill of \$3,600, an enormous difference, which should make ship owners pause and think. These figures are based on a fuel consump-

tion of 0.73 pint per brake horsepower hour for the gasoline engine, and 0.50 pint per brake horsepower hour for the Diesel engine. The latter type can reduce its consumption to 0.45 pint, but not many gasoline engines consume less than 0.73 pint under working conditions. The following is a test report of the engine of G. D. I., made by the British Corporation Registry's surveyor:

Certificate of Trials

At the request of Messrs. Diesels Motorer, Ltd. Stockholm, I have this day made trials with a Marine-Polar-Motor, No. 11011, built at their works for the Southern Whaling & Sealing Co., North Shields, and consisting of four working and two maneuvering cylinders.

After several hours' continuous run, a test was made during 30 minutes to determine the consumption of fuel at full load, the results of which were as follows:

Mean net load noted	142 kgrm.
Mean number of revolutions per minute	282
Mean effective work, B. H. P.	207
Consumption of fuel per 30 minutes ..	19,600 gr.
Consumption of fuel per hour	39,200 gr.
Consumption of fuel per hour and B. H. P.	196 gr.

The brake horsepower was measured by a brake-arrangement from Messrs. Heenan & Froude, Ltd., of Manchester, and the fuel (Solar oil) supplied by Messrs. Forsberg & Mark, of Stockholm.

Another test was made during 10 minutes to ascertain the maximum effective work, when the following results were obtained:

Net load noted	152 kgrm.
Number of revolutions per minute ..	292
Effective work, B. H. P.	222

Very satisfactory trials were also made of stopping, starting and reversing the engine.

The exhausting gases seemed to be quite colorless, and the working of the engine was very regular and without any sign of warming in the bearings.

G. BREMBERG,

Surveyor to the British Corporation Registry.

Stockholm, June 6, 1911.

New Steamer Atlantic City

The Atlantic City Transportation Co., which has operated a service between Atlantic City and Philadelphia, has decided to establish a first-class passenger and freight service between Atlantic City and New York. Kyle & Purdy, City Island, have constructed the hull and the Staten Island Ship Building Co. are installing the machinery in a new steamer to be known as the Atlantic City. The new steamer will be 186 ft. long, 28½ ft. beam, 14½ ft. deep to main deck and 23 ft. to upper deck. The propelling machinery will consist of a triple-expansion engine with cylinders 15¼, 23¼ and 37½ in. in diameter x 26 in. stroke supplied with steam from two Almy water-tube boilers.

The Newport News Ship Building & Dry Dock Co. has more work on hand at present than it has had at any time during the past seven years.

Crude Oil Engines

By Walter Pollock

So much attention has recently been paid to the Diesel engine in the public prints that one does not hear much of the great progress that is being made with a similar type of internal combustion oil engine, i. e., the "hot bulb type," and although they are not being made in large powers, there are at present under construction and at work engines developing over 100 I. H. P. per cylinder, and one unit of nearly 450 I. H. P. for four cylinders—not very far removed from the Selandia's 1,250 for eight cylinders.

The points that will interest most ship owners are the costs and comparisons, and the following figures will show how very much more advantageous they are than those of the Diesel engines referred to:—

For 900 I. H. P. in each case.			
	Steam.	Diesel Bolinder type, hot bulb.	
Cost	£4,750	£7,250	£4,750
Weight, tons, machinery complete	135	135	37
Machinery staff	10	8	4
L'g'h machin'y space	0 ft.	40 ft.	21 ft.
Cost of mach'y staff	£116	£100	£45

It is not difficult to see where the difference in cost comes in, and the great saving in favor of the "hot bulb" type when it is known that the latter have no valves, tappet rods or cam-shafts, no air pumps on main engines or separate auxiliary air pumps, and it is therefore difficult to see why the cost of the "hot bulb" type should not ultimately cost less than half that of the Diesel type, and say two-thirds of the cost of the steam machinery.

The weight of the "hot bulb" type must of necessity be considerably less because of the smaller size of the engine, the dispensing with the rods, shafts, valves, etc., and the avoidance of air or compression pumps.

This is largely reduced because of the greater simplicity of Bolinder type of engine and the fewer working parts. The simple arrangement enables an ordinary marine engineer to take charge, and does not necessitate a specially trained expert. Most of your readers will, we think, be a little surprised at the numerical strength of the Selandia's engine room staff, and will ask—why eight engineers for machinery of only 2,500 I. H. P.? All supporters of this progressive industry of internal combustion engines will join in the hope that in practice it will not be found necessary to have such a large staff.

Whilst owners are considering the type of engine to adopt for larger powers, they will not hesitate as to the type for smaller powers, as the "hot bulb" types of 50 and 75 I. H. P. per cylinder have been at work

successfully in this country for over 12 months, with results that your readers can judge for themselves.

For two months (January and February, 1912) a well-known manager undertook to work two heavy-powered fishing vessels together in the Irish fishing at the north of Ireland, and his report of the results gives the following comparisons:—

Steam Vessel.	
Dimensions:	86.4-inch by 18.5-inch by 8.8-inch
Speed:	10 1/4 miles.
Expenses—	
Coals	£79 11 2
Wages	15 0 0
Dues	11 1 2
Stores	3 5 6
Total expenses	£108 17 10
Heavy Oil-Engined Vessel	
Dimensions:	82.9-inch by 18.3-inch by 9.9-inch
Speed:	11 miles.
Expenses—	
Fuel	£35 13 8
Engineers' wages	15 0 0
Dues	11 2 3
Stores	10 14 1
Total expenses	£72 10 0

The great progress that British owners of commercial vessels are making may not be generally known. There are at present at work or on order 85 Bolinder-engined vessels for Great Britain alone, and at least 40 "hot bulb" heavy oil engines of other makes, and the demand is so great that prompt deliveries of the best make are difficult to obtain.

Oil for internal combustion engines is being gradually standardized, and as soon as the 50 tankers that are at present under construction are delivered, will enable a further 1,500,000 tons of oil to be transported from the oil fields to the markets of the world. The supply of oil is even now much greater than the demand, and as soon as the transport facilities referred to are in operation the price will come down. Labor troubles, strikes, such as those of the recent railway men, coal miners, etc., will not and cannot affect the supply and delivery of oil as it can coal, and ship owners will appreciate what this means when they consider their losses at the present time when freights are so high.

Improving Indiana Harbor

Secretary Stimson of the war department has transmitted to the house of representatives the recommendation of the chief of engineers of the army for the construction of a breakwater at Indiana Harbor, at a cost of \$1,033,200, and the construction of shore connections at an additional cost of \$108,900, for the eastern breakwater and \$200,000 for the northern breakwater in case experience indicates their advisability.

The recommendation is based upon

satisfactory assurance being given to the secretary of war that the piers will be reconstructed at the expense of local interests since such reconstructed piers will when the proposed filling is completed form re-vestment to private property, and that suitable docks and wharves will be built and maintained by the municipality of East Chicago.

P. D. Block, president of the Inland Steel Co. has advised the war department "in case the United States will agree to build an outer breakwater to protect the entrance of Indiana Harbor, we would agree, at our own expense to build an easterly entrance pier in prolongation of a line as laid down on the harbor line map, out to a point where it will intersect another line (indicated on the map) extended in a northwesterly direction."

The mayor of Chicago has advised the secretary of war that it has purchased the land for construction of the dock or wharves necessary to secure the breakwater.

Trans-Atlantique Liner France

The trans-Atlantique liner France reached New York on her maiden trip on April 27. Both hull and engines were built at the St. Nazaire yard of the Chantiers de l'Atlantique. She is the largest and speediest vessel under the French flag and is the first French liner to be driven by Parsons turbines, driving four propellers, aggregating 45,000 S. H. P. The new steamer is 715 ft. over all, 665 ft. between perpendiculars, 75 ft. beam and 52 ft. deep. Her launching weight was 11,500 tons and her displacement at loaded draught is 28,000 tons. She is expected to make 23.5 knots in regular service.

The Long Beach Steamship Co., Long Beach, Cal., has been organized by C. H. Windham and has elected the following directors: George H. Bixby, Llewellyn Bixby, P. E. Hatch, D. F. Tucker, P. H. Updike, C. J. Walker and George L. Craig. The company is capitalized at \$500,000, of which \$175,000 is paid in. The company has ordered a new freight vessel to be 200 ft. long and to have a carrying capacity for 1,000,000 ft. of lumber.

The San Juan Fishing & Packing Co. has given contract for a steel oil-burning vessel to J. F. Duthie & Co., Seattle, Wash., to replace the steamer Grant, which was wrecked near Prince Rupert. The new steamer will be 140 ft. long, 25 ft. beam and 13 ft. 6 in. deep.

Loss of the Steamship Titanic

*Some Lessons to be Derived From the Sinking of the World's
Greatest Liner—A Most Appalling and Lamentable Tragedy*

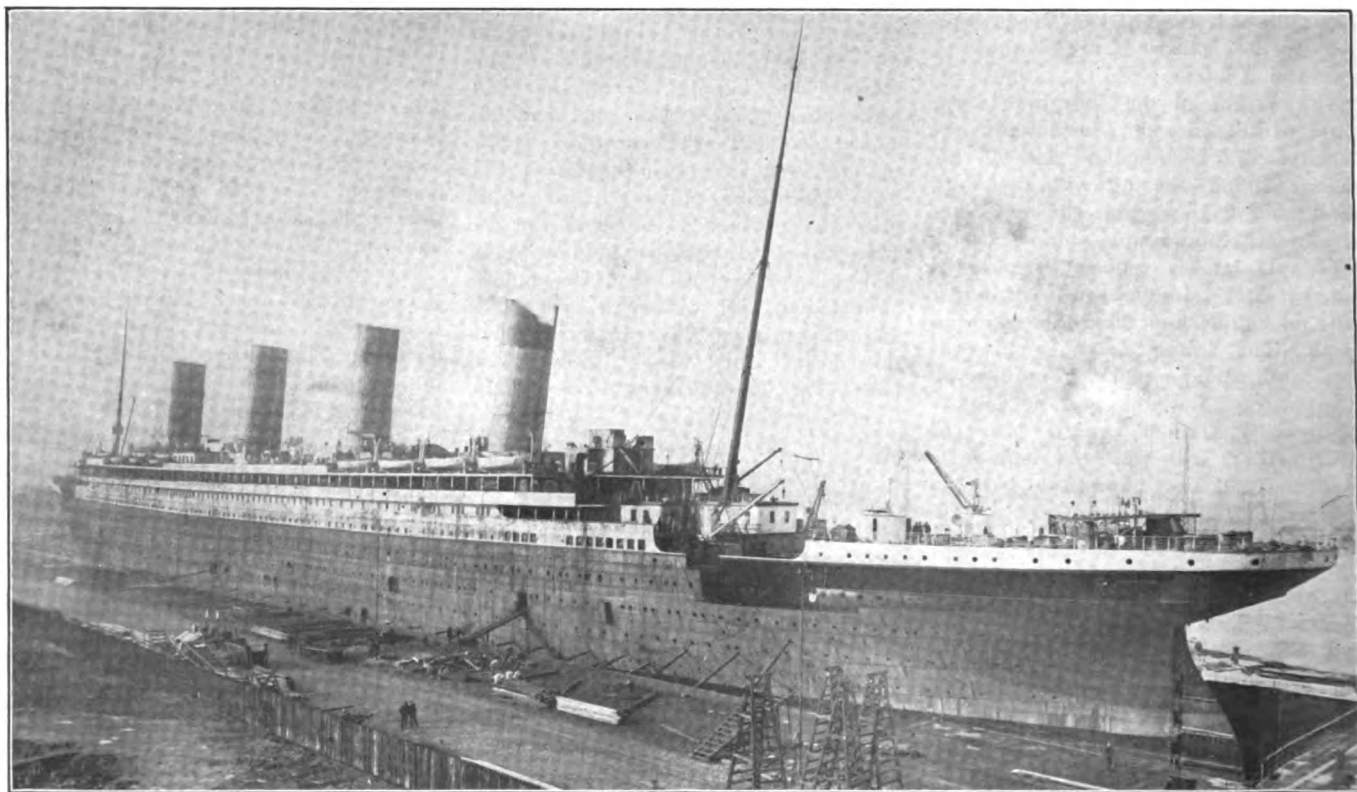
THE disaster which overtook the White Star Liner Titanic, on Sunday evening, April 14, was the most terrible in the history of the sea. Since man as a gregarious animal has fashioned a ship, nothing finer or stouter than the Titanic ever left port; and yet within four days after she left port on her maiden trip she was at the bottom of the ocean. No single incident of recorded time has impressed mankind more than this. The Titanic was called the unsinkable ship and in the ordinary circumstances of navigation she was unsinkable. The ripened experience of experts and the thought of a thousand brains had gone into her construction. She was designed to survive collision and would in all probability have survived collision with another ship. She was designed to that very end and the puncturing of a couple of her compartments would not have seriously disturbed her buoyancy. The lessons from the Republic had been worked out in the Titanic and her watertight bulkheads would doubtless have withstood any such similar injury as the

Florida inflicted upon the Republic. It required exactly the kind of accident that occurred to sink the Titanic—and that was striking a glancing blow at full speed against the underwater shelf of an enormous iceberg, ripping her starboard side from bow to amidships open to the sea and rendering her watertight compartments inoperative and useless. She received a mortal wound from which no ship at present designed could recover, and under which any ship, other than the Titanic, would have sunk earlier. The energy of the blow is calculated at 1,161,000 foot-tons.

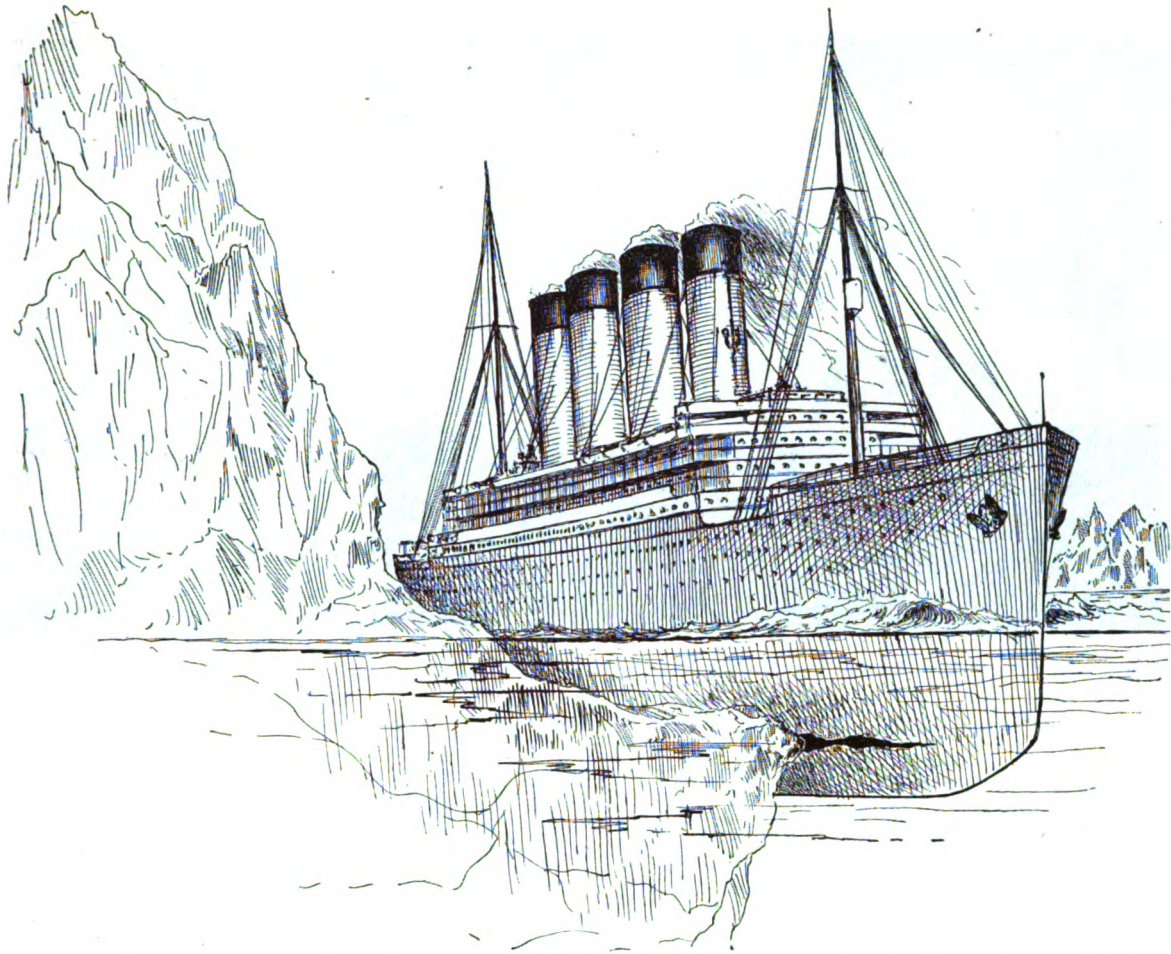
As soon as the news was flashed from Halifax that the Titanic had struck an iceberg, the whole civilized world was on the qui vive. The first reports were such as to allay apprehension, indicating that the injury was not mortal and that the Titanic was either proceeding slowly into port under her own steam or was being towed to Halifax. It was not until Monday night that the appalling admission was made that the Titanic

had actually sunk. Meanwhile underwriters that had heavy lines upon the steamer reinsured at 50, 55 and 60 guineas per cent. The rate dropped from 60 to 25 and even 20 guineas upon the receipt of more favorable information. Much indignation was expressed over the false and misleading reports that were given out on Monday, but subsequent developments tended to show that two separate wireless messages, caught in the air, had been blended into one and made it appear that the Titanic was being towed, whereas it was an oil tanker that was being towed. It was days thereafter before any real information of the disaster could be obtained. The newspapers published pages upon pages of matter, but not one line of real information as to what had actually happened to the ship. It was not until the Carpathia came in with the survivors that any actual information was forthcoming. On April 21 the White Star Line issued the following official statement of the disaster:

"Titanic followed strictly southern-



THE TITANIC IN DRY DOCK AT BELFAST, TAKEN JUST BEFORE SHE LEFT FOR SOUTHAMPTON TO PROCEED ON HER MAIDEN
TRIP



THIS PICTURE DEPICTS WHAT IN ALL PROBABILITY HAPPENED TO THE TITANIC. SHE STRUCK A MASSIVE, PROJECTING UNDERWATER SHELF OF AN ICEBERG, RIPPING OPEN HER BILGES ON THE STARBOARD SIDE FROM NEAR THE BOW TO PRACTICALLY AMIDSHIPS. THE ENERGY OF THE BLOW IS ESTIMATED AT 1,161,000 FOOT-TONS

From the Scientific American

most track, westbound, changing courses at corner 47 meridian, 42 latitude, then south 86 degrees west. True all officers watch perished except Fourth Officer Boxhall, who was working observations the chart room and making rounds. Night perfectly clear starlight. No wind, sea calm. Had encountered no ice previously. Proceeding with vigilant lookout full speed, but reduced consumption, probably 21 to 22 knots. Engineers all perished. 11:45 p. m., April 14, ship sighted low-lying berg directly ahead. First officer starboarded helm, reversed full speed and closed all compartments starboard side. Boats board bow. Slight jar but grinding sound, evidently opening several compartment starboard side. Boats cleared, filled with women and children, lowered and sent off under responsible persons. Ship sank, bow first, 2:20 a. m. All boats away except one collapsible. Carpathia rescued 4 a. m. Discipline perfect."

It will therefore be seen that the Titanic remained afloat after the collision for 2 hours and 35 minutes.

The United States senate promptly began an investigation of the acci-

dent, issuing subpoenas for members of the crew and survivors. While it is true that Senator Smith, through his lack of knowledge of maritime practice, asked a great many foolish questions, it is also true that he developed a great deal of information which will be extremely useful in formulating remedial legislation, and whatever the British papers may say about it, the inquiry will bear much fruit of value to ocean travelers in the future. In fact, it has already done so.

Change of Route Ordered

While the Titanic was traveling on the southernmost track for westbound ships, established by international agreement as safe for this period of the year, the leading steamship companies have issued orders to follow a lane 100 miles further south where icebergs are unknown. Icebergs are practically unknown on the lane that the Titanic followed, but consideration probably was not given to the unusual length and severity of the past winter, which created a condition that may not again be realized in several

generations. It is true that Capt. Smith was warned that he might encounter ice, and he has been condemned for driving his ship at such a speed under such conditions; but it is doubtful if he did anything that was not custom. The men in the crow's nest, the lookout men in the bow and the officers on the bridge were unquestionably straining their eyes ahead for any sign of danger. It is the testimony of experienced officers that the movements of icebergs are most unaccountable. A ship may hear that bergs are ahead in a certain latitude and longitude and on reaching the position no trace of them can be seen. Mariners say that there is no question concerning navigation so uncertain as the diagnosis of the presence of an iceberg. It is probably true that Capt. Smith was merely taking the same chance that he had taken for 40 years successfully, and which are probably taken by every captain of an express steamer; but which in all probability will not be taken by any of them again. Moreover, there is some reason to believe that the latest bulletin regarding the proximity of ice may not have been



PHOTOGRAPH OF AN ICEBERG TAKEN OFF THE NEWFOUNDLAND BANKS

transmitted to the bridge of the Titanic at all.

Cyril Evans, wireless operator on the steamship Californian, testified that he had warned the Titanic that the sea was crowded with ice, receiving in reply a message from the Titanic's operator to keep out as he was sending private messages for passengers to Cape Race. It would be some satisfaction to know whether this message was transmitted to Capt. Smith. The inquiry has developed the absolute necessity of government regulation over the wireless and the imperativeness of having respon-

sible wireless operators on duty both night and day. The Californian appears to have been the nearest ship to the Titanic, but got none of her frantic C. Q. D. messages because she carried only a single operator and he retired shortly before the collision occurred. Another evidence of irresponsibility on the part of the Titanic's operator was the calling of the operator of the Frankfort a fool because he asked what was the matter in reply to the C. Q. D. message.

The discipline aboard the doomed ship appears to have been perfect—largely accounted for doubtless in the

settled belief of the passengers that she was unsinkable, and that moreover the impact had been slight. Within 10 minutes, upon order of Capt. Smith, the wireless operator was sending out his calls for help and the women and children were being quietly, though rapidly, put aboard the lifeboats. Captain Smith knew within 20 minutes after the collision that the Titanic was doomed. Thomas Andrews, the designer of the boat, was below and told him that the ship could not be saved. The women were averse to getting into the boats, believing the ship itself to be safer, but were persuaded by the men to do so. The boats were launched without excitement and got away safely with the exception of one, though not in all cases with a full complement of passengers. It was probably not until the Titanic had ominously settled by the head that the male passengers became at all alarmed. Towards the last the scene must have been one of indescribable horror. The inclination of the deck towards the bow gradually increased and the stern gradually rose and she slowly settled until the waters engulfed her completely. From the accounts of all survivors, nothing like a rapid plunge occurred until only a portion of the hull at the stern remained above water. The suction, therefore, was probably not considerable.

Survivors are also agreed that the lighting system remained in operation until the ship practically went under—mute testimony to the care with

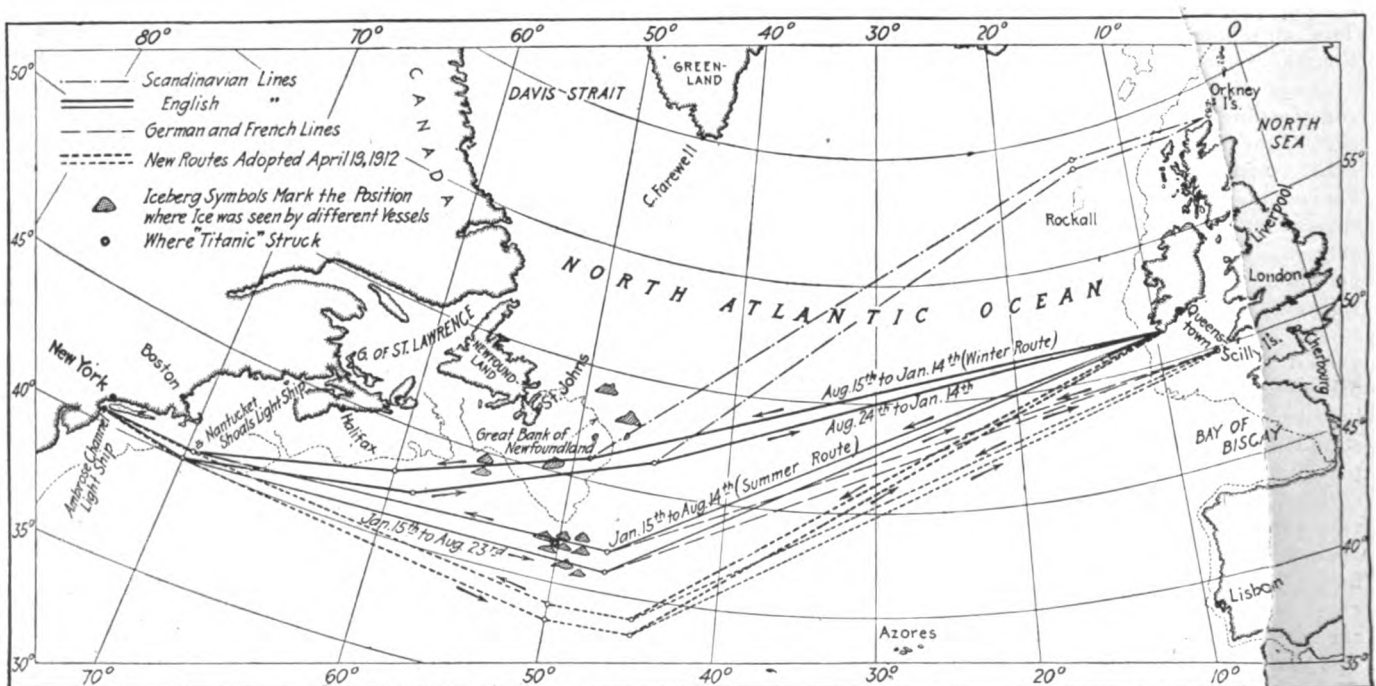


CHART OF THE NORTH ATLANTIC, SHOWING THE NEW SUMMER ROUTES FOR STEAMERS. THE TURNING POINTS ARE INDICATED BY SMALL OPEN CIRCLES

Prepared from information furnished by hydrographic office by Engineering News.



THE SENATE COMMITTEE HEADED BY SENATOR SMITH, EXAMINING J. BRUCE ISMAY, MANAGING DIRECTOR OF THE WHITE STAR LINE, AT THE WALDORF-ASTORIA, NEW YORK. MR. ISMAY IS SEATED AT THE TABLE WITH HIS LEFT HAND TO HIS CHIN

Copyright by Underwood & Underwood, New York.

which the great hull has been constructed. Some survivors tell of having heard a series of explosions after submergence, probably due to the breaking of the after bulkheads.

The most pitiable thing of all is the fact that every soul might have been saved had there been adequate life-saving appliances aboard. The Titanic had only sufficient life boat capacity for one-third of the passengers. The sea was like a sheet of glass and for the time being the occupants of the life boats were as safe as though they were afloat on a mill pond. It is not fair, however, to censure the White Star Line for this lack of life-saving equipment. The Titanic carried life boats in excess of the requirements of the British board of trade. The trouble is that the board of trade regulations are absurdly inadequate to meet modern conditions. The board of trade regulations call for the carrying by ships of 10,000 tons and over of a minimum of 16 boats with a total minimum cubic capacity of 5,500 cu. ft. Moreover, the board permits a reduction to be made in the number of boats provided the division of the ship into watertight compartments is efficient, and as this condition was realized by the Titanic, the law called only for 8,250 cu. ft., sufficient for 825 passengers. The Titanic, however, carried 20 boats (14 life boats, two cutters and four collapsibles), which was well in excess of the board of trade regulations, but somewhat under that of the American law, which requires all vessels of 20,000 gross tons to carry life boats of a total capacity of 12,420 cu. ft., with an addition of 225 cu. ft. for each successive 500 tons over

20,000 tons. The board of trade regulations need drastic revision because the modern steamship has long since passed 10,000 tons. Steamships should, and doubtless will hereafter, be required by law to carry life saving equipment sufficient to accommodate every passenger. The leading lines have spontaneously done this since the Titanic disaster, but it should be borne in mind that the conditions for a life boat living in a sea are not always as ideal as they were on the night of the Titanic disaster. The first security of the passenger must rest in the strength of the hull of the liner itself against all ordinary vicissitudes of the sea; and, secondly, in that prudent and careful navigation which takes no chances in known dangers.

Precious Lot of Human Freight

It was a precious lot of human freight that went down with the Titanic. There were many conspicuous and distinguished men and some, not so well known, but of enormous usefulness to the world. We refer to the staff of engineers and architects from the yard of Harland & Wolff, 20 of whom were aboard watching the working of the various features of the great ship and all of whom were drowned. Archibald Frost, the builders' chief engineer; R. Chisholm, the chief ship yard draftsman, and Thomas Andrews, the designer of the vessel, who notified Capt. Smith that the Titanic would sink, remained below and went down with her.

All accounts of the disaster preserve the best traditions of the sea. The early accounts that certain ships

had passed near the Titanic's position without offering aid are erroneous. Every ship that caught the appeal for help instantly turned about and headed for the stricken vessel, doubling the stokehold force and repeatedly sending messages to reassure the Titanic. Especially noteworthy was the performance of the rescue ship Carpathia. Captain Rostron's terse statement speaks volumes for his own efficiency. The little details mean so much, the sending up of rockets every 15 minutes to "reassure Titanic", the orders to the crew to get "Christian names and surnames of all survivors as soon as possible to send by wireless", the orders to have "all of the officers' cabins placed at the disposal of the rescued", to get out the "canvas ash bags in order to get infants and children aboard with the greatest safety"—all these show a spirit of preparedness and efficiency. Meanwhile the Carpathia, usually a 15-knot steamer, was making 18 knots in the night, depending absolutely for her own safety upon the alertness and vigilance of the lookouts.

Many of the survivors speak of seeing lights in the distance which they took to be those of other vessels. In all probability they mistook the stars on the horizon for the lights of vessels. The atmospheric conditions were peculiar and the stars were hanging low or setting in the water, as the mariners say.

One of the bitter things to recall is the fact that at least six life boats left the Titanic without a full complement of passengers. They contained 192 altogether, while having accommodation for 300. In other words, 108 more persons could have

been saved than were saved with the equipment available. It is difficult to understand why these boats were not filled, and it can only be reasonably accounted for by the fact that the officers, filling them, expected that the boats would presently return. At any rate that circumstance appeared in the testimony of Second Officer Lightoller. He says that he placed 24 persons in the first boat and 32 persons in the second boat. While loading the third boat, however, it dawned on him that the situation was getting serious and he began loading more heavily, taking some chances with the tackle. When he loaded his first boat the boat deck was 70 ft. above the sea, but when he loaded the sixth boat the boat deck was only 10 ft. above the sea, proving that there was little time to lose. All the boats safely got away as stated with the exception of one collapsible, First Officer Murdoch losing his life in the endeavor to detach it from its fastenings. Lightoller himself stood on top of the officers' quarters as the ship took her final dive. He describes the crew's nest as being level with the water when the bridge was entirely submerged. As the ship dived he dived also, but

was sucked against a blower and held there. He added that a terrific gust came up the blower as the ship went down and blew him clear. He swam around in the water for 90 minutes, climbing aboard an overturned collapsible boat, the same one that Murdoch had been struggling with. Eventually 30 persons managed to reach it and crawl up on it.

There has been criticism that so large a part of the crew were saved in comparison to the number of passengers saved, but as a matter of fact, five out of every six persons that were picked up out of the water were either firemen or stewards. There has also been criticism of inexperienced sailors aboard, but it should be borne in mind that a crew of 800 had been assembled together for the first time and that there could not be the same cohesion or selection as though they had sailed together for months.

The iceberg that wrecked the ship is described as a low-lying one. Frederick Fleet, the lookout who first detected it, says that it appeared to him to be about the size of two big tables, that he sounded three bells and telephoned the bridge that it was directly ahead. The engines were reversed and the helm starboarded but

almost immediately thereafter the collision occurred. The visible part of the berg then appeared to Fleet to be about 75 ft. high. The night was very clear with stars visible on the horizon.

The survivors numbered 705, of which 210 were members of the crew. The dead numbered 1,442, of which 846 were passengers.

The question of the liability of the White Star Line for damages is one upon which admiralty lawyers are at variance. It was at first contended that the Harper act would apply limiting liability to the value of the ship and its passenger and freight receipts; but it is now contended by some that the presence aboard of J. Bruce Ismay, managing director of the line, who was among those saved, coupled with the high rate of speed in the presence of ice, will make the Harper act inoperative and lay the company open for full damages. In that event the aggregate of possible damages would be staggering.

The British inquiry into the disaster will be conducted by Lord Mersey, who, as former president of the admiralty court, has had a wide experience with maritime affairs.

Construction of the Titanic

She Was the Product of the Many Brilliant Minds—How Harland & Wolff Build the Giant Liners—Cofferdam Construction Suggested

By W. J. Wood

MUCH has been said and written during the past week anent the appalling disaster to the leviathan steamship Titanic, the most perfect work of naval architecture the world has ever produced. As a naval architect who spent several years on the designs and construction plans of the then largest ships afloat, the Teutonic and Majestic, of the White Star Line, I should like to say a word for the builders and the ship. It is a well-known fact in Europe, and also among the profession on this continent, that Harland & Wolff are the highest priced and most painstaking ship builders in Europe. They build their ships, engine and equip them utterly regardless of cost and particularly so with the White Star Line, as that work is done on a profit percentage basis of actual cost of ship. Their help from the designing staff down to the most unskilled

laborer is paid on a high scale, and the employment by Harland & Wolff of a man in my profession was a passport to the best ship yards in the world. They always had a waiting list of men for their staff. The great Vulcan Works, of Stettin, Germany, is run along the same lines.

To say, as I have seen quoted in some papers, that Lord Pirrie was the designer of the Titanic is ridiculously absurd, and his lordship would laugh at such an implied compliment if he saw it. The Titanic is the product of many brilliant men's brains, each and every one a specialist in their own particular line. On the hull staff alone there is Mr. Mullan, the firm's naval architect of over 30 years' experience with the firm; his first assistant chief, Joseph Guthrie, and leading hand, Weston Grimshaw, any of these men capable of going out into any part of the world in business for themselves as consulting

naval architects. Further, what was called the White Star staff, comprising about 30 men in the hull-designing department, and as many more in the machinery, were the pick and choice of engineering training and talent of the English-speaking world.

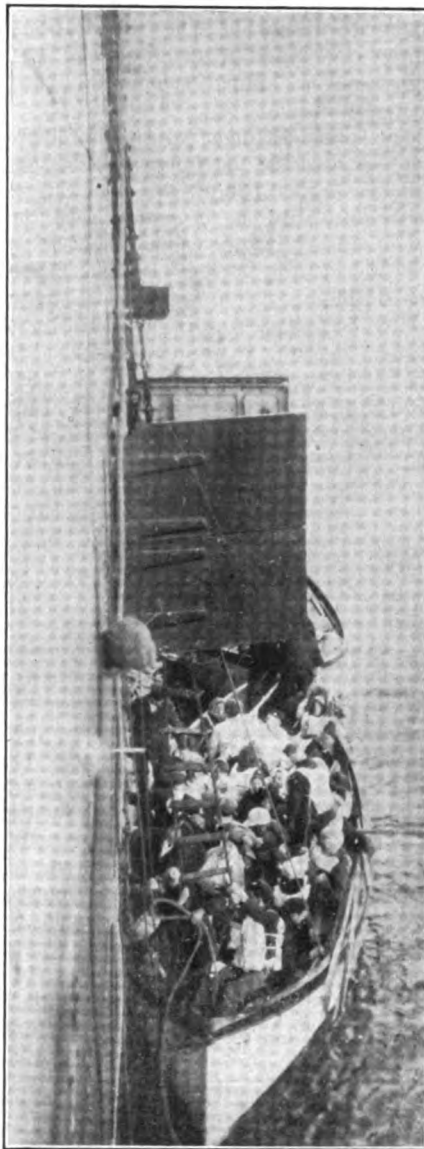
When the Germanic was built about a quarter of a century ago, she was considered the peer of the ship builders' art, and the great Titanic is an evolution of the Germanic, each new ship as it came out being a little bigger and a little better than its predecessor, as witness the vast stride made since the Teutonic and Majestic came out about 20 years ago. Let me cite one example of the thoroughness of the builders' methods. After we had all the calculations completed as to draught and trim and stability of the Teutonic and Majestic, a model of the hull was made in zinc on scale of $\frac{1}{4}$ inch to the foot, or 48 times smaller than

the ship itself. This shell model was floated in salt water and weighted down to its load draught. It then was subjected to bilging with water of various of its watertight compartments to prove practically and conclusively that the ship would float with any two of the compartments bilged or in free and open communication with the sea either in forward or after end of vessel. The result of this elaborate test was highly satisfactory, provided the bulkheads would withstand the pressure in heavy seas. At that time bulkheads were not as strong as they should be, and a British commission was formed to look into the matter of changing construction of bulkheads. They were called the bulkhead committee and sat in deliberation for months, with the result that their findings were adopted by all the underwriting societies rules for the building of vessels and thereafter put in practice by ship builders.

System of Bulkheads

For the information of the laymen I should state that bulkheads are simply partitions of steel built of plate, fitted vertically inside the ship and stiffened on one side vertically and on the other side horizontally by great channel columns such as we see used on lower portions of our skyscrapers in the city. These stiffeners are spaced 30 in. apart on one side and 4 ft. apart on the opposite side of plate. The intent and purpose of the bulkhead committee's findings were that these bulkheads should be as strong as the outer shell of ship if by accident they were ever exposed and in open communication with the sea. Those that are built across the ship are termed "transverse bulkheads" and when the ship is sub-divided at the middle line and the bulkhead running lengthwise of hull it is called a longitudinal bulkhead.

The late Sir Edward J. Harland, Baronet, the founder of the firm of Harland & Wolff, was the first to conceive and inaugurate the use of the raking stem or prow now used on all White Star liners, as well as others. His contention was that with the stem head raking forward at the top, in the event of collision it would be the first point of contact and before it should be crushed back to the perpendicular line at load water line the force of the blow would be expended and all the structural work sprung or damaged would consequently be above load water line with no resultant leakage of any extent. Another good feature of the forward raking of stem is that by increasing



ONE OF THE TITANIC'S LIFEBOATS
ALONGSIDE THE CARPATHIA
Photograph from Underwood & Underwood, New York.

the length of deck over that of the water it caused the vessel to have what is termed a flaring bow, which throws head seas away to either quarter without shipping them aboard on deck, or something after the style of the ordinary plow in cutting the sod.

Another feature of the disaster to the Titanic which tells a significant tale to the expert, is the fact that all the electric lights kept burning until she sank. This means that her dynamos held to their sole plates in spite of the shock and that the cable or wire connections were not stretched, strained or snapped, showing conclusively that the immense hull held together without shearing her riveted longitudinal connections until she foundered. A remarkable performance for such a structure aground on a bottom as hard as rock.

I maintain that the Titanic was

built in accordance with the best modern practice and to withstand any disaster or so-called acts of Providence that human ingenuity could conceive of, and that if she had collided with anything head on, even the rock of Gibraltar, she would be today afloat and all her precious load of passengers saved. But she did not strike head on (as I surmised on receipt of first dispatches) but glided up on a growler or shelf of ice, thereby tearing her bottom out below the bulkheads and ripping her bilges lengthwise just above her tank double bottom and admitting the sea into several holds at once. Had the ripping been done near the keel or on the flat of the bottom and not above her tank top or double bottom, she might still have been afloat; as that inner skin or shell about 6½ ft. above keel extended from bilge to bilge across the ship's holds.

Cofferdam Construction

This brings me to the discussion of the only safe ship to meet and encounter such so-called ice growlers with impunity. The ship that would do this would be of what is called the cofferdam construction, and as here briefly described. Built with a double bottom like the Titanic, but instead of stopping it at the turn of bilges of hull, or 6½ ft. from bottom of boat, this double bottom extends up inside the outer shell to a height of about 18 in. above deep load or draught line of vessel. At the top or shelf on this cofferdam the space between the outer and inner shell is only 18 in. wide, or sufficient to allow a man in there who holds on against rivet heads while the work is riveted up during construction.

The United States lighthouse board own two such vessels, built in Cleveland, O., in 1891-92, under the writer's supervision and named respectively the Lilac and Columbine. They are still both afloat in service and were at one time stationed at Woods Hole, Mass. It may be asked, in the light of such common knowledge of naval architecture, why was the Titanic not built that way, seeing that it would positively have saved the ship and lives of all aboard. The answer is simply this, the first cost of construction would not be a deterrent, but the carrying capacity of the holds would be cut down enormously, and ships constructed along the plans I have outlined would require to be exclusively passenger steamers and charge excessively high fares to pay operating expenses. The lighthouse tenders mentioned above are used only to carry provisions and

supplies to lighthouses on the coast and consequently have small holds for such cargo. Their double bottom or space between the inner and outer shell is used to carry the fresh water supply to lighthouses.

In regard to life boat capacity, I may add that the builders of the Titanic have always had the reputation of supplying more boats and life-saving appliances than the laws called for and also exceeding the weight of scantling going into their ships as called for in Lloyds rules, as the writer knows from personal experience. There is only one line on Lake Michigan that provides life boats and life rafts for an excess of the number of passengers they carry, except on their daylight excursion boats, and that is the Goodrich Transit Co., which has made this a rule since 1895, and also have all their boats furnished with fire pumps and a water sprinkling system. The writer thinks that a firm that takes the lead in such measures in life saving, deserves creditable mention in the public press.

Watertight Doors of Titanic

The staff of Harland & Wolff had given much thought to the operation of the watertight doors in the bulkheads of the Titanic by electric power, involving a new form of me-

chanical design. The illustrations show the chief feature of the design and its most substantial construction.

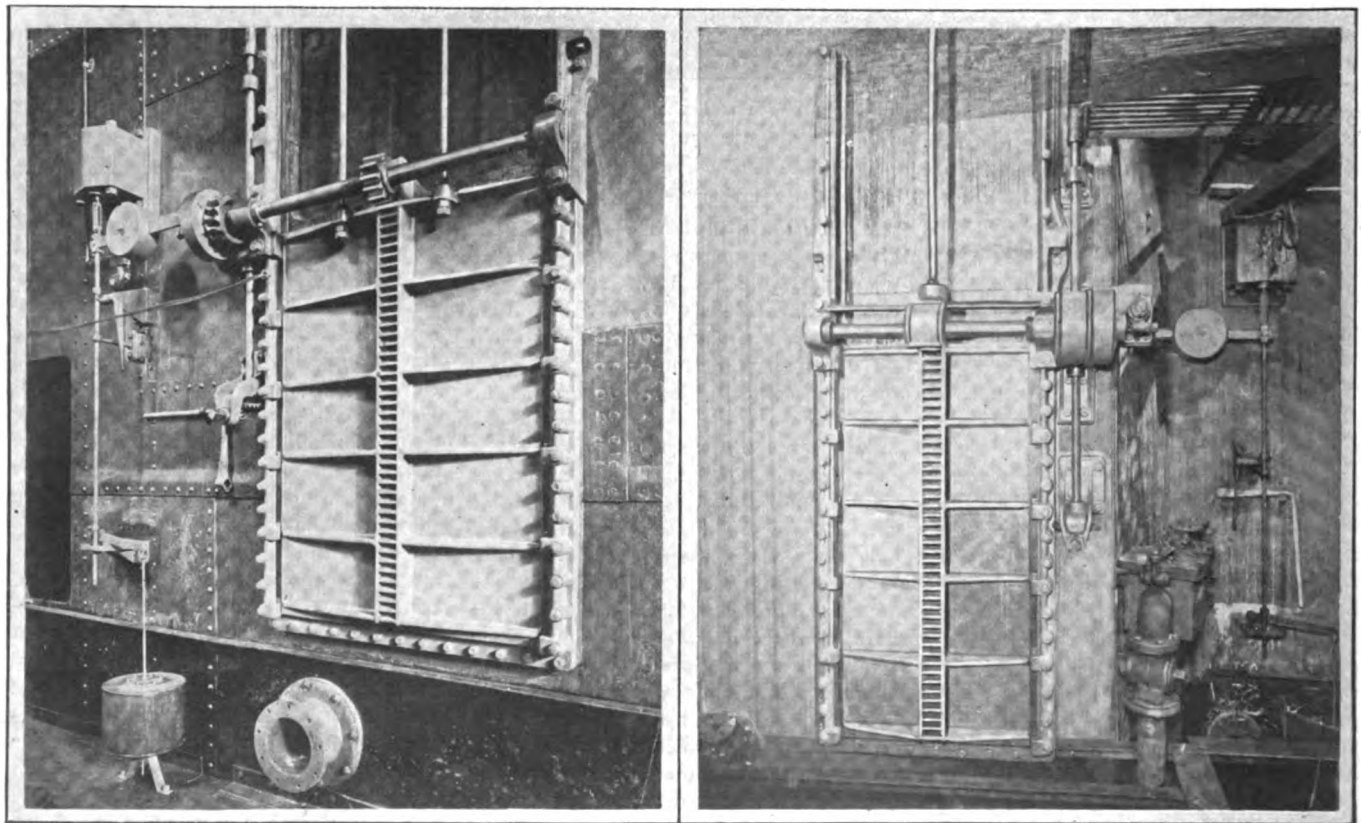
The principle upon which the doors are operated is as follows: Friction clutches normally hold the door in its uppermost position, in which case the opening between the compartment is at its full aperture. This friction clutch can be disengaged instantly by a strong electro-magnet, which is connected to a circuit controlled from the captain's bridge. The closing of the electric switch by the captain will close all the watertight doors throughout the vessel, thus isolating the compartments. In addition to this, local operation of the doors is effected by means of a mechanical lever attached to the friction clutch and an automatic feature in connection with the device is that should water enter into the compartment owing to an accident, a float system underneath the floor level will automatically operate in order to close the doors leading into that compartment, if they have not already been mechanically operated locally or electrically controlled from the bridge. In order to prevent too sudden a fall of the heavy watertight door, the closing speed is controlled by means of an oil dash pot or cataract; the motion therefore, although sufficiently rapid to avoid a huge influx of water, is yet smooth and acts without shock. Adjacent to each door is an electric bell alarm which rings immediately before

the door closes in order to give the alarm to those who are located in the compartment concerned, and should by any means in the event of sudden operation any of the men become imprisoned in the compartment, an escape ladder is provided in each watertight compartment so that the man can reach the deck even after the watertight doors are closed. The installation affords a good example of both mechanical and electrical design carried out on a very large scale and is, therefore, a notable example of specialized engineering.

Scope of British Inquiry

In outlining the purpose and scope of the British inquiry into the Titanic disaster, Attorney General Isaacs stated that 26 questions would be taken up—eight relating to happenings before the casualty; six to warnings given the Titanic and the resulting precautions taken; ten to the casualty itself and consequent events; one to the equipment and construction of the vessel, and the last to the rules of the Merchant Shipping Act. The 26 questions to be asked the witnesses are in substance, as follows:

1. What were the numbers of the passengers and crew, their sex, etc.?
2. Did the Titanic comply with the requirements of the act complying to passenger steamers?
3. Was there a special provision in



THE HEAVY ELECTRICALLY OPERATED WATERTIGHT DOORS OF THE OLYMPIC AND TITANIC

the design of the vessel for safety?

4. Was the steamer fully officered and manned?

5. What was the number of lifeboats, was the number sufficient, and had there been a boat drill?

6. Regarding the installation of the wireless system, was it in effective order, and what was the number of wireless operators?

7. Were there any, and if so what, instructions, given to the master regarding the navigation of the steamer?

8. What track was taken by the Titanic; was it the one usually followed; was the track safe at that time of the year, and did the master have any discretion regarding the track taken?

9. What information reached the Titanic of the existence of ice; and was the course altered in consequence of this information?

10. Was there a proper lookout for ice maintained; after the warning was received were directions given to vary the speed, and were the directions carried out?

11. Was there an equipment of searchlights and binoculars and was such equipment necessary?

12. What precautions were taken by the Titanic when ice was met?

13. Did any one see the reported ice before the casualty occurred; what measures were taken to avoid the ice, and were these measures proper?

14. What was the speed of the vessel immediately preceding the casualty, and was it excessive under the circumstances?

15. What was the nature of the casualty?

16. When the casualty occurred, what steps were taken immediately; how long a time elapsed after the casualty before its seriousness was realized; what steps were then taken and what endeavors were made to save the lives of those on board and to prevent the vessel sinking?

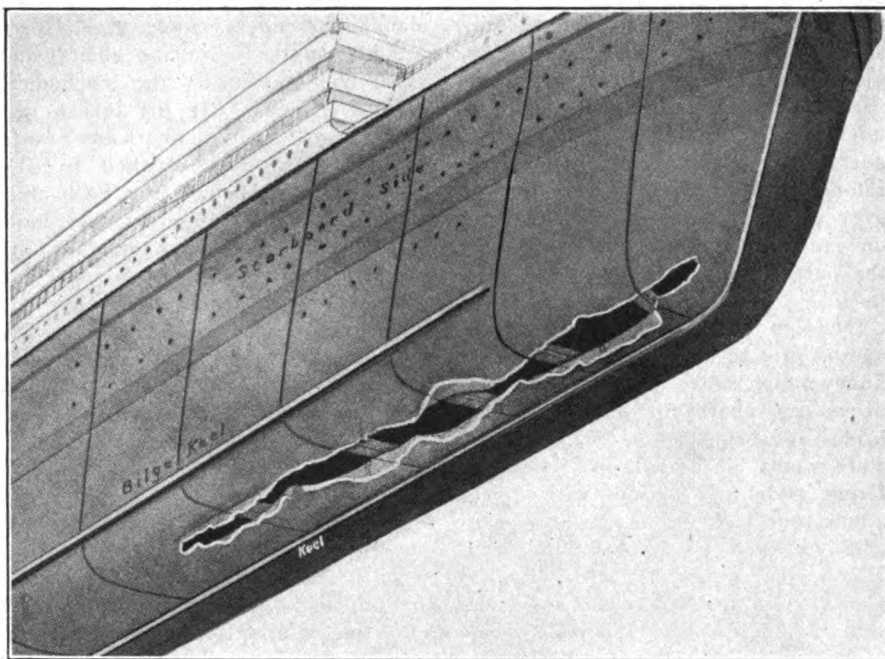
17. Was proper discipline maintained after the casualty?

18. What messages, asking assistance, were sent out and what answers were received?

19. What apparatus was there for lowering the lifeboats; what was its efficiency; did the boats get away under proper superintendence, and were the boats properly manned?

20. Did the lifeboats prove efficient in saving life; what was the number of passengers and crew in each boat on leaving the vessel; how was the number made up with regard to the sex and class rating, and did the boats carry full loads; otherwise, why not?

21. What were the numbers of the



THE PROBABLE NATURE OF THE TITANIC'S INJURIES

passengers of the first, second and third class respectively who were saved; what was the number of the crew saved; having regard for their ratings and sex; and what was the proportion of the different classes of passengers and the different grades of the crew saved to their total numbers on board, and what reason was there for a disproportion if such there was?

22. This question further develops points covered in question No. 21.

23. What were the happenings on board the liner after the casualty occurred up to the time she foundered, and what was the cause of the loss of the Titanic and the loss of life that ensued?

24. This question further develops the subject of question No. 23.

25. What was the construction and what was the adequacy of the equipment of the Titanic?

26. This, designated as the final question, constitutes a request to the court to report upon the rules and regulations of the Merchant Shipping act and to make recommendations with a view to promoting the safety of vessels and persons at sea.

The Sailing of the Titanic

In the light of subsequent events the following description, taken from the London *Standard* of April 10, of the Titanic's departure from Southampton possesses a most pathetic interest as it prophetically depicts what a splendid creature she was and under what magnificent setting she began a voyage which she was destined never to finish. The account was

written by the *Standard's* Southampton correspondent:

Amid the cheering of an enormous crowd and the waving of a forest of handkerchiefs the new White Star liner Titanic (the largest and most complete passenger vessel in the world) sailed for New York on her maiden trip at noon to-day.

Viewed from Trafalgar Quay, in the brilliant setting of Southampton water, under a blue sky flecked with fleecy clouds, and the ocean greyhounds of yesterday—the St. Louis, the Oceanic, and many others—dwarfed in the near distance, the scene was tremendously impressive. Within the week Southampton has sent forth the two greatest liners in the world—the Olympic and Titanic—a record in itself.

Never before in the history of the mercantile marine has so great a triumph of naval architecture as the Titanic left a port. So there was a new sensation in the occasion of this leviathan's movement—a monster, towering to the flags above 160 ft., deck over deck, and with a length of 876 ft.—as she rounded the Test Quay, majestically displayed her lines, and bore down on the Solent.

Sunshine to Order

An officer aboard told me to-day that he had been on the Titanic four and a-half days, and, apart from his own sphere, knew very little about her. In three hours, having walked some six miles, new wonders and improvements revealing themselves in all directions, one was only able to take "samples" of extraordinary interest in

themselves, and of great importance to the ocean traveler. On the Titanic sunshine is being taken out. The gloom and depression of November's fogs off the Banks have been annihilated. The first-class passenger sits down to dinner in the splendid saloon, with its windows of cathedral-grey glass, and the attendants switch on cunningly hidden electric lights on the outside. The effect is naturalness itself.

One can engage for £870 the voyage a "private ocean trip." There are honeymoon suites, with honeymoon decks set apart for the millionaire brides and bridegrooms of the future; state-rooms decorated in every different style and period, with lovely, ample cot-beds in brass, mahogany and oak; lounges decorated in Louis XV style; verandahs with climbing plants and ramblers; real coal fires as well as hundreds of radiators; restaurants and cafes; reception-rooms upholstered in the daintiest silk, with gorgeous panels and richly carved cornices—the whole forming an impressive ensemble in perfect taste, satisfying to the eye.

There were but 1470 passengers, besides the 800 members of the crew and scores of attendants, on board to-day, so that there was no crowding in any part of the vessel. Fully an hour before she sailed the gymnasium, in charge of a professional gymnast, was in working. On one side a lady was having a camel ride and recalling the delights of the Pyramids; in an-

other corner there was a bicycle race; many passengers took their own weights on the automatic chairs, and some had a spin on the mechanical rowing machines. In the squash racquet court two Americans were "fighting the battle of their lives"—it might have been at the Bath club, so thoroughly at home did they look.

In the third-class or steerage departments the loveliest linen, glass and cutlery were displayed ready for luncheon, while the easy chairs, card tables, pianos and settees reminded one of the first-class accommodation on many liners 20 years ago.

Trips of Discovery

But the most fascinating feature, perhaps, of the Titanic today was the trips of "discovery." Men and women set out to explore. They were shot into the depths by splendidly equipped electric lifts. They called at the post office for a chat with the post-master on the sorting arrangements. They wandered to the swimming baths and the luxurious Turkish saloons. They examined the kitchens, with their 21,000 dishes and plates, tons of silver and cutlery, and acres of glass and linen. They touched the pianos on every deck in every corner of advantage, or listened to the band; scanned the array of novels and more serious works in the libraries; and learned all sorts of wonderful things about the electric buttons which control this 47,000-ton vessel, command its en-

gines and its little army of services alike.

At 11:45 the bells clanged. The visitors wandered down the gangways. Hatchways were closed. The tugs snorted, and the Titanic set out on her maiden trip. But scarcely had she moved 600 yards into the bay when it was evident that something unlooked for had occurred.

Moment of Excitement

Among the crowds still waving handkerchiefs there was a sudden silence. The gigantic triple expansion engines had begun to work. Near by were the Oceanic and the New York—great vessels in their day—now dwarfed to comparative insignificance. Directly the huge screws of the Titanic began to revolve the suction caused the seven great stern ropes of the New York to part, and the American liner's stern swung round into mid stream.

All eyes were fixed on the New York. It looked as if there must be a collision; but, as a matter of fact, there was no real danger. The Titanic's screws were stopped almost instantaneously, and the New York was towed to safety. Then the Titanic slowly sped down Southampton Water, the faces of her passengers peering at every nook of the seven tiers along the whole length of the liner, until she melted away in the distance, and her maiden voyage had begun.

Channel Steamer Newhaven*

An Account of Her Service and Behavior in the English Channel—Liquid Fuel Suggested and Its Advantages Pointed Out

By P. Sigaudy

SPEED, regularity on service, and rapid maneuvering are the most important qualities for passenger steamers crossing arms of the sea and establishing communication between neighboring continents, especially on short-trip services. From this point of view it will be of interest to communicate to the members of this institution the service results of the steamer Newhaven during the first five months on the route between Newhaven and Dieppe.

Briefly, the dimensions of this vessel are:—

	Ft. In.
Length between perpendiculars.....	292 0
Length over all.....	302 0

*Paper read before Institution of Naval Architects.

Beam	34 7
Depth	22 2
Maximum draught.....	9 8

Accommodation is provided for 1,000 passengers.

The machinery consists of three Parsons turbines; one high-pressure turbine driving the center screw, and two low-pressure turbines driving the two wing screws. The reversing is done on the two wing screws. The boilers are of the water-tube type. The starting platform is on the main deck level, in a roomy and well-lighted position, in which all the controls are assembled. The main regulating valve, the two maneuvering valves, the by-pass, the heating-through valves, and the lubricating system are all handled from this central position.

The change-over from ahead to astern, or the contrary, is effected in four seconds, and the vessel can be stopped in a distance of 295 ft. from a speed of 12 knots.

The contract trials consisted of a double crossing between Dieppe and Newhaven, at a time of tide to be selected by the owners, in order to neutralize the effect of currents. The duration of the run from Dieppe to Newhaven was 2 hours, 43 minutes, 51 seconds, and from Newhaven to Dieppe, 2 hours, 43 minutes, 5 seconds, giving a mean speed of 23.85 knots, the distance from light on pierhead to light on pierhead being 65 nautical miles. These trials were run on May 26 and 27, 1911.

The Newhaven was put in service

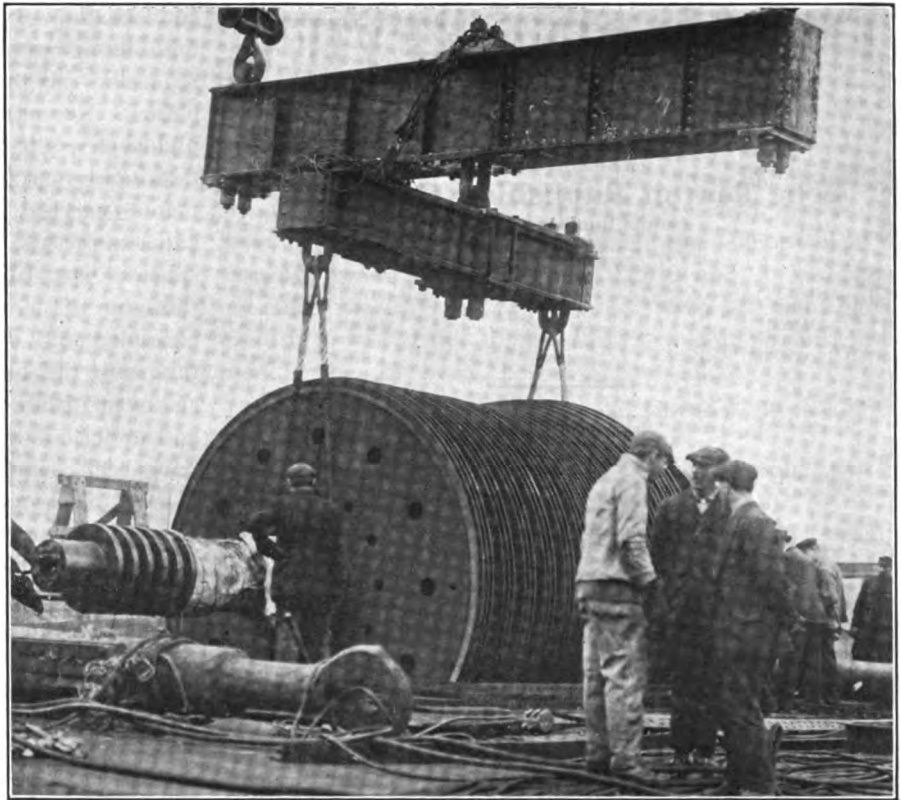
on June 2, and ran till Oct. 20, inclusive, being then withdrawn for inspection at the expiry of the guarantee period. Between the above dates she made 126 crossings, the mean time of which was 2 hours, 51 minutes, 25 seconds, corresponding to a mean speed of 22.70 knots. The fastest trip occupied 2 hours, 43 minutes (slightly less than the trial runs), with a favorable tide. The slowest trip took 3 hours, 6 minutes, in bad weather. The mean coal per trip was 29 tons 4 cwt., including that consumed in raising steam and maintaining the fires in harbor. Although it has not been possible to obtain exact information, this quantity of coal may be approximately divided as follows:—5 tons 1½ cwt. for raising steam and losses on arrival, and 24 tons 2½ cwt. for the trip from pierhead to pierhead.

Results Better Than Expected

These results are notably better than those anticipated by the owners, who stipulated that the crossing should be made in three hours on the official trials. They may be attributed in the first place to the turbines of the Parsons type; further to the special arrangements adopted for the auxiliary machinery, which was worked out on a destroyer basis, though with additional scantlings to insure long-continued wearing qualities. For instance, the steam valves are of cast steel, the air-pumps of gun metal, the condenser shells of steel plate, etc. As a matter of fact, the inspection at the end of the guarantee period proved that all the parts were in perfect condition, and showed no signs of fatigue; no damage was found, and everything was closed up again without repair or renewal.

It may now be recognized that there is no disadvantage in employing for such vessels the same mechanical arrangements as for destroyers. Why not also for the boilers? Why not fire them with liquid fuel?

Mr. Milton, in his paper on "Diesel Engines for Sea-Going Vessels", clearly demonstrated the considerable advantages of liquid fuel for ships:—Evaporative effect, 50 per cent greater, less space required and greater facilities for storing the fuel; more perfect combustion and better utilization of the boiler-heating surface; absolutely regular production of steam at a constant pressure; finally, handling of the fuel reduced to its simplest expression, since shipping, stowing and feeding to the fires are carried out mechanically by means of pumps. Further, it should be taken into consideration that channel steamers have to start under a full head of steam, with the fires already



ROTOR OF CENTER TURBINE OF BATTLESHIP RIVADAVIA

forced, that they must keep this head of steam up to the moment of arrival, and that the waste of coal is reproduced at each departure and arrival, which may be several times a day. Now, with liquid fuel, these wastages at each arrival and departure do not exist. In fact, one can compare under these circumstances the firing of a boiler with the management of a lamp, which one lights, turns up and down, or on and off, without waste of oil. Briefly, the economical advantages of this system of firing are the greater the less the duration of the trips, and the greater their number.

Comparison of Fuels

Were this institution an association of owners, this short note might be completed by a balance sheet comparing the two fuels, based, for instance, on trips of 25 nautical miles, with four crossings daily; but it will suffice if there be given the consumption of fuel and the number of firemen in the case of coal fuel and in the case of oil fuel, based on the results of the Newhaven. In the case of coal fuel the consumption per trip would be 14 tons, 6 cwt., including that used for raising steam and losses in port. With liquid fuel this figure would be 8 tons, 13 cwt., only. For coal firing, 18 firemen and two leading firemen are necessary. For liquid fuel, four firemen and two leading firemen are sufficient.

The author will only point out to

engineers how attractive is the solution. Certainly, liquid firing for boilers is the complement to turbines for ship propulsion.

The plant works without dirt, noise, or apparent fatigue, with complete flexibility, and without assistance from the human hand, under the control of a few intelligent mechanics, who watch the pressure-gages and regulate the valves from time to time.

One of Rivadavia's Rotors

Herewith is shown a view of the lowering of the rotor for the central turbine of the Argentine battleship Rivadavia, at the yard of the Fore River Ship Building Co., Quincy, Mass., on April 11. The rotor weighs 144,600 lbs. The ship is fitted with three Curtis turbines of a nominal H. P. of 13,500 each, although it is expected that the three turbines will develop upwards of 50,000 H. P. when forced. Much of the auxiliary machinery is already in position, boilers are complete and the condensers are ready to be installed as soon as the turbines are in position. The trials of the ship will take place early in the fall.

The Dollar Steamship Co., of San Francisco, has given contract to the Craig Shipbuilding Co., of Long Beach, Cal., for a steamer for the coastwise trade to cost approximately \$200,000.

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The Titanic Disaster

When the world is suddenly confronted with so appalling a tragedy as that of the sinking of the Titanic, two sets of emotions are likely to occur. One is sweeping condemnation of the whole system of ocean passenger transportation, and the other a quiescent mood which seeks to find in the accident a combination of circumstances that may never occur again. In the shadow of so great a tragedy it is difficult to see clearly; but our duty now is to survey the facts and circumstances and extract from them whatever

counsel they have to offer. No nobler structure than the Titanic was ever built by man. Into it, as Ruskin so well said, "man had put so much of his human patience, common sense, forethought, experimental philosophy, self-control, habits of order and obedience, thoroughly wrought handwork, defiance of brute elements, careless courage, careful patriotism and calm expectation of the judgment of God." That this splendid structure, the fabrication of the concentrated thought of a thousand minds, should be crushed, crumpled and sunk as the result of a moment's contest with the forces of nature, is a lesson learned at an awful price. But since he emerged from the cave and undertook the winning of the earth, man's lessons have been dearly bought.

Let us examine the structure that perished. The Titanic was constructed with a double bottom, very heavily riveted by hydraulic power, having a center keelson, 5 feet 3 inches deep, with a flat keel plate, 1½ inches thick below it, and with a series of twelve heavy 'tween bottom girders extending fore and aft, in addition to the transverse members of the structure, so that there was possible great structural resistance to the action of ice below the ship. Moreover, fifteen transverse watertight bulkheads were fitted, judiciously disposed throughout the vessel, the after bulkheads extending to the saloon deck and the forward bulkheads extending to the deck next below. Not only was the vessel well subdivided, but the greatest pains were taken to see that each bulkhead could at any time be made to fulfill its functions. The openings of the bulkheads were fitted with watertight doors and the resources of modern mechanical invention were taxed to the utmost with a view to obviating danger. Each door could be closed from the upper deck in the usual manner and in addition the captain or other officer by operating a switch on the bridge could close any door throughout the ship. Should either or both of these means fail, there yet remained a third. A small cylinder containing a float was fitted on the tank top which, upon being lifted by any entering water, would automatically set in motion mechanism for closing the doors. It would, therefore, appear that the Titanic was well protected against the effects of a head-on collision or a direct blow amidships. It will be seen that the subdivision of the Titanic's hull was practically entirely transverse and it was the irony of fate that she should have struck a glancing blow against the under-water shelf of an iceberg, ripping open her sides, rendering the elaborate system of bulkheads and bulkhead doors useless. The phrase "unsinkable ship" did not originate with the builders, who nevertheless had wrought into the hull all that it was possible to foresee to prevent loss from foundering.

The loss of the Titanic brings up pertinently the question of wing or longitudinal subdivisions. Compared with the Mauretania, the fore and aft length of the Titanic's compartments was relatively small; the width, however, was the full width of the ship, 90 odd ft., compared with the 57 ft. in the Mauretania be-

tween the fore and aft bunker bulkheads which are from 10 to 16 ft. in from the vessel's side and extend in an unbroken line for 280 ft. Had the Titanic's hull been judiciously subdivided in a fore and aft direction as well as transversely, she might be afloat today. This question of wing bulkheads will undoubtedly be given careful consideration in the future design of broad-beamed ships, but it must be borne in mind that there is a very large body of expert opinion opposed to longitudinal compartments on the ground that they would give a heavy list to a vessel and might even cause it to capsize. Suitable cross connections, however, might be a guard against this condition.

There has been much hysteria in the papers regarding the lack of life saving equipment and at a conference of steamship owners, independent of governmental action, it was decided to arrange that life boats should be carried to accommodate every soul on board an ocean ship. The British Board of Trade, too, has been thoroughly awakened to the serious nature of its remissness of duty in not revising its regulations to meet the rapid advance in the size of ships. It is a dreadful pity that there were not more life boats on board the Titanic, though in fairness to the owners it should be stated that she carried more than the law required and quite as many as are carried on other ocean liners. The sea was providentially smooth and the boats, when launched, were in no danger from the elements. The fact must not be lost sight of, however, that the life boat is the last resort, and that the prospects of a life boat living in the seas usually prevailing on the North Atlantic are very slight. Moreover, it is doubtful whether a sufficient number of boats to carry a full complement of passengers and crew could be launched much under five or six hours, by which time relief might be expected from passing vessels through the wireless. Second Officer Lightoller's testimony was to the effect that the boat deck of the Titanic was 70 ft. above the sea when he launched his first life boat and that it was only 10 ft. above the sea when he launched the sixth; and in fact the ship sank while First Officer Murdoch was struggling to release the last collapsible boat. In the time that she remained afloat the Titanic could probably not have launched a sufficient number of boats to accommodate all on board. It is not well to put an undue emphasis upon auxiliary life saving equipment. The real security of the passenger lies elsewhere.

One thing, however, is certain, and that is that a closer regulation of the wireless is necessary. The instruments should be more powerful and operators should be on duty both day and night. A well regulated and intelligent wireless constantly alert to catch the call for help is the life saver of first importance. We will not minimize the need of life boats; nor will we magnify it. It is well to have them on board and ways can undoubtedly be worked out

for stowing them, but the lowering difficulty is a very serious one and a pronounced list may rob a vessel of half its boat accommodation at once. Then again the circumstances are not usual, but exceptional, when they are found to be of real value on the North Atlantic. It was most fortuitous that when the Florida rammed the Republic and the Titanic struck the iceberg, the sea was quiet, but when the Cunard liner Pavonia broke down in mid-Atlantic and it became necessary to convey a rope to the tramp steamer that eventually towed her to the Azores, a crew of picked men could just keep their life boat afloat and were forced to abandon it on their return, being pulled aboard the Pavonia by ropes.

The lesson of the Titanic, however, is one that never will be forgotten. In the annals of the sea it will survive when other disasters will have faded from recollection. More than any other event, it will tend to make future navigation safe. Already steps have been taken to provide by international agreement what routes shall be traversed by steamers on the North Atlantic, what speed shall be maintained when dangers are known to exist, and what further provisions in the way of auxiliary equipment, such as searchlights, may be necessary or desirable.

The naval architect will attack with greater zest the problem of creating a ship that will withstand any shock that it is possible to foresee and yet remain afloat until help may reasonably be expected. The builder, the navigator, and the government, will work to a common goal that never again shall a great ship with her burden of souls plunge to the bottom of the sea.



Controlling Foreign Steamship Lines

The house committee on Merchant Marine and Fisheries has unanimously reported in favor of the Humphrey bill which seeks to prevent ships identified with any foreign combination operating in violation of the Sherman anti-trust law from landing at American ports. This measure was revised by Attorney General Wickersham at the suggestion of Mr. Humphrey and is favored by the administration. The bill is designed to give the United States government a means of enforcing the Sherman law in cases of foreign combinations and pools which are now difficult to reach, because there is no way of enforcing penalties. The bill makes possible the sale of the vessel adjudged to have violated the Sherman anti-trust law and prohibits it from entering at or clearing from any port of the United States under penalty of \$25,000 for each violation.

The report of the Committee on Merchant Marine and Fisheries is a vigorous one, maintaining that over 90 per cent of the over-sea trade of the United States is carried by foreign ships that belong to rings, pools, conferences and combinations between which there is absolutely no competition.

Schooner's Remarkable Record

For Consistent Sailing the Pacific Coast Schooner Wilbert

L. Smith is Quite Distinguished—Analysis of Her Record

FOR consistent sailing no lumber carrier operating on the Pacific coast is believed to have the record of the American schooner Wilbert L. Smith, Capt. A. S. Ross, owned by the Globe Navigation Co., of Seattle. Other American vessels on the Pacific, of which the number is constantly decreasing, have made more brilliant records for individual voyages, but none is known to have performed so consistently for several years as has the Wilbert L. Smith during the past four years. Since October, 1908, the Smith has made six voyages to South American ports and also one coastwise voyage to California from Puget Sound. She is now on her seventh voyage to Callao, carrying lumber.

"The closest kind of attention to business, both in port and at sea, has resulted in this splendid record," is the statement of George F. Thorn-dyke, manager of the owning company. Mr. Thorn-dyke is willing to give the credit to Capt. Ross and does not attribute the schooner's record so much to her sailing qualities as to the ability and energy of the man who has commanded the vessel since she was launched, ten years ago, in Seattle. He took the vessel when she was built and has handled her ever since with the exception of one voyage to Fremantle, Australia. The four-master has been engaged in various trades and has rendered excellent service at all times, but in making the above statement, Mr. Thorn-dyke referred more particularly to the schooner's service between North Pacific and Peruvian and Chilean ports.

The Wilbert L. Smith is a typical lumber carrier, many of which flying the American flag are still carrying forest products to off-shore ports. This vessel is of the following dimensions: Gross tonnage, 848; net tonnage, 710; length, 184 ft.; beam, 40.5 ft.; depth, 14.2 ft. She carries a total complement of 12, including master. There are six seamen before the mast. She is well adapted for the economical handling of lumber and for her tonnage carries offshore the large cargo of 975,000 ft., of

which about three-fifths is stowed underdeck and two-fifths on deck.

Looking at the map it is a com-

paratively short distance from North Pacific ports to Callao. However, sailing vessels are compelled to make a long detour owing to the light and contrary winds prevailing off the southerly winds along the coast which carry them north to the port of destination. By reason of this a sailing vessel's route to Callao is 8,460 miles in round numbers, whereas the return, made much more direct, logs less than 5,000 miles.

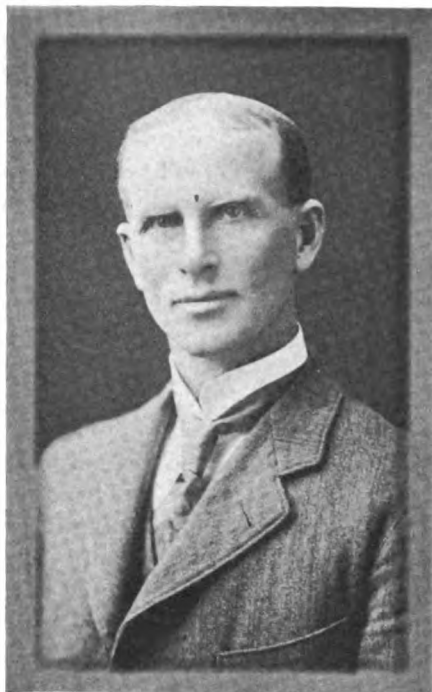
The average passage by sailing vessel from the North Pacific to Callao is about 80 days, and, although it has been done in 58 days, and again vessels have required from 188 to 125 days, the master who can make Callao in 75 days is considered to be doing very smart sailing. Consequently the consistent performance of Capt. Ross' vessel can be seen when it is stated that during the six voyages he has made to Callao, he has averaged 71 1/3 days. His longest outward passage during this time was 85 days and his best was but 61 days.

Returning from Callao, the sailing master usually first encounters light and baffling winds, then the calms of the doldrums. Picking up the northeast trades he is frequently driven far to the westward and then in the North Pacific he is likely to meet strong head winds. However, the average is about 50 days, although recently several vessels have been more than 60 days. But in the six voyages referred to, Capt. Ross has averaged 43 1/6 days on the return,

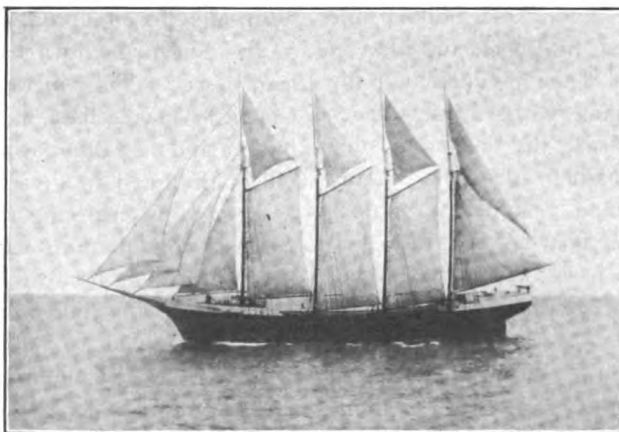
his longest northward passage having taken 47 days and his best 40 days, two others having been logged in 41 days each. In this time he has spent 150 days in the discharging port, averaging but 25 days, which is a remarkable record when it is considered that Callao has always been a port of aggravating delay. Not many years ago foreign windjammers with lumber were frequently in port from two to five months discharging. On these six voyages the Wilbert L. Smith has carried approximately 5,856,000 ft. of lumber, which

means that in loading and discharging Capt. Ross has had the handling of 11,712,000 ft.

Considering that the average outward passage to Callao is 80 days and the return 50 to 60 days, the



CAPT. A. S. ROSS



SCHOONER WILBERT L. SMITH

west coast of South America. Consequently, windjammers have to sail usually below latitude 40 degrees south before they turn to the east. Thence they take advantage of the

following table showing the Smith's record on her six voyages to South America gives an idea of her consistent performance.

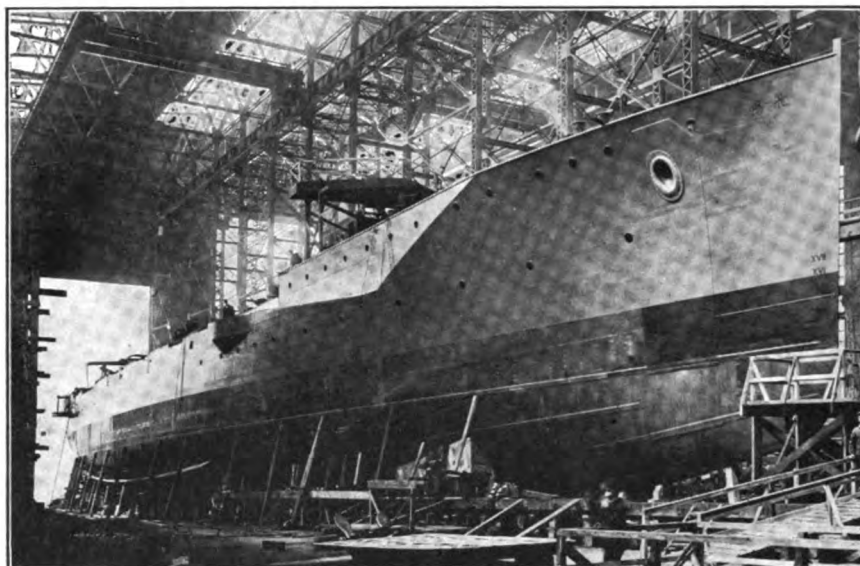
	Outward.	In Callao.	Return.
Voyage 1.....	85 days	25 days	45 days
Voyage 2.....	69 days	30 days	41 days
Voyage 3.....	75 days	27 days	47 days
Voyage 4.....	68 days	25 days	45 days
Voyage 5.....	61 days	21 days	41 days
Voyage 6.....	70 days	22 days	40 days

This makes an average outward run of 71 1/3 days, an average in discharging port of 25 days and an average return passage of 43 1/6 days. This has all been done between Oct. 19, 1908, and Jan. 4, 1912, and includes a coastwise voyage consuming about five months. In this time the Smith has sailed 48,144 miles by steamer course or probably close to 70,000 miles by sailing ship route. While all of Capt. Ross' service in the Smith shows class, the equal of his last two voyages to Callao has probably never been equalled by like vessels in this trade. These last two voyages were made in four months and five days and four months and 12 days, respectively. When it is stated that the average sailor requires six months to return after he leaves Puget Sound loaded for Callao, the record of the Smith can better be understood.

Still Talking About It

In 1905, Capt. Ross made a record voyage in the Smith that is still commented upon in Pacific sailing circles. Sailing from Vancouver, B. C., with lumber for Kobe, Japan, March 21, the Smith made the Japanese port April 20. While this was a remarkably smart run, the Smith's returning record is far better. She left Kobe May 14 and passed in from sea at Cape Flattery, June 7, having made the run across the North Pacific, approximately 4,500 miles, in 21 days. This record has been equalled by other windjammers, but many tramp steamers have required much longer. While at Kobe, Capt. Ross had a visit with Capt. G. V. Williams, of the American steamer *Lyra*, a passenger and freight liner then operating between Tacoma and Manila. Capt. Ross remarked that he would meet Williams in Seattle. The latter acquiesced rather sarcastically. Both vessels left Kobe the same day, the *Lyra* calling at Yokohama for a few hours. When the steamer arrived at Port Townsend, the Smith was lying in that bay peacefully at anchor and Capt. Williams could hardly believe his eyes.

During this passage Capt. Ross did his best to beat the steamer and that he succeeded was due largely to his daring in carrying sail and his attention to business. He transferred his bed from his quarters to the com-



THE CHINESE CRUISER FEI HUNG ON THE STOCKS AT CAMDEN

Photo by New York Ship Building Co.

panionway, where he snatched brief intervals of sleep with one eye open. Sail was never taken in except when the wind threatened to carry something away and right across the broad Pacific the Smith ran like a hunted hare. But he had the satisfaction of besting a fairly fast liner.

Capt. Ross is a native of Nova Scotia, which has produced so many splendid sailors. He secured his early training in the North Atlantic in the smart schooners then engaged in the fruit trade to the West Indies. There he learned the value of time and he has been applying his early experiences in the Pacific. He brought the old schooner *Nellie Coleman* to Seattle about 12 years ago. After selling her he engaged in steamboating on the Yukon river until he took command of the *Wilbert L. Smith*, ten years ago. Capt. Ross is very fond of his little schooner, which he is willing to match against anything afloat that carries sail. The Smith is named after Wilbert L. Smith, of Syracuse, N. Y.

Chinese Cruiser Launched

The Chinese cruiser *Fei Hung* was launched on May 4 from the yard of the New York Ship Building Co., Camden, N. J. The cruiser was christened by Miss Alice Chang, the young daughter of Ambassador Chang Yin-Tang. The *Fei Hung* is 330 ft. long and 39 ft. 6 in. wide, and will be used as a training ship.

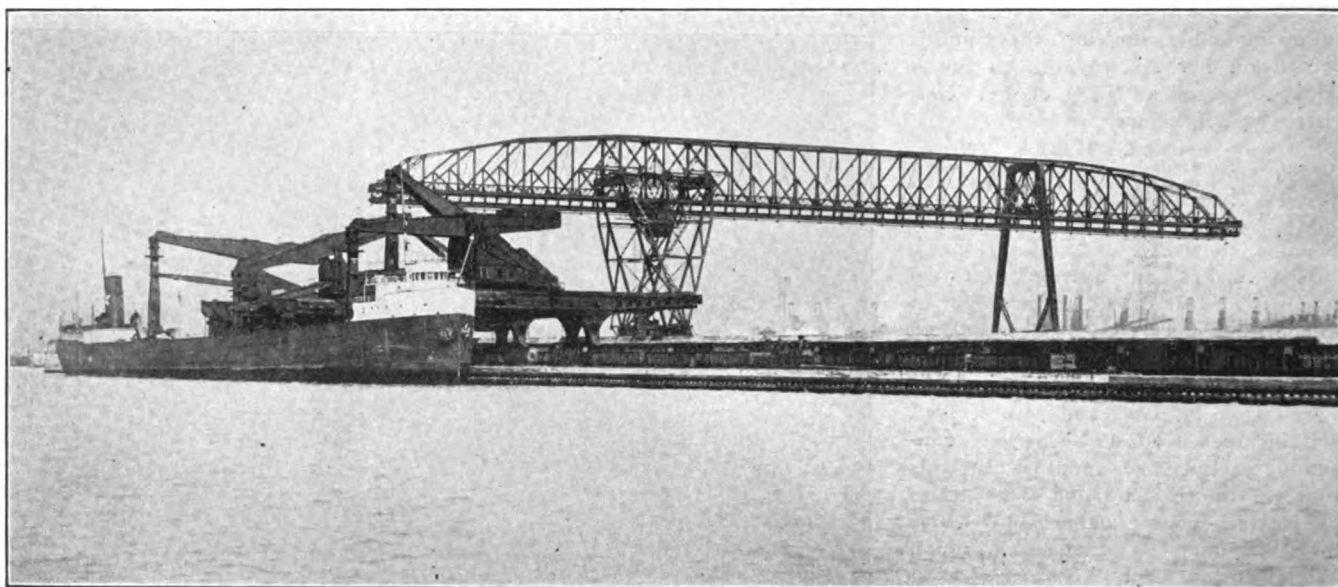
Raymond Releasing Hook

James R. Raymond, 8 Bright street, New York City, the designer of the Raymond releasing hook for life boats, has since the Titanic disaster

received quite an impetus to his business. This, of course, is natural. The Raymond releasing hook is an improvement on what is known as the standard automatic releasing hook, a device for lowering and detaching boats which is more extensively used than any other device for this purpose in existence. The improvements upon it are the result of years of experience. Some of the advantages of the new hook are: The fin on the back of the hook prevents the shackle from passing back or upwards far enough to allow it to fall in behind the bill of the hook while detaching or being hooked on, and also aids in starting the shackle to fall; the shackles are made to conform to the shape of the hook when seated, thus making the boat more secure when hanging in the davits and prevents the possibility of its twisting off of the hooks when swinging the boat outboard or inboard; the perfect fitting of the shackles to the hooks obviates the necessity of mousing the hooks, except while carrying the boat outboard in a rolling sea, when the boat might become water-borne.

Through a misunderstanding of signals, the steamship *Alameda* ran full speed into the *Coleman* dock at Seattle on April 26, plowing entirely through the structure and ramming and sinking the steamer *Telegraph* which was moored on the other side of the dock.

Dry dock No. 4 at the New York navy yard, which has been under construction since 1903, is now practically completed, and will be turned over to the yard officials in the near future. The dock is over 700 ft. long and 110 ft. wide.



THE NEW PENNSYLVANIA RAILWAY ORE DOCK IN THE WEST BREAKWATER AT CLEVELAND

New Pennsylvania Ore Dock

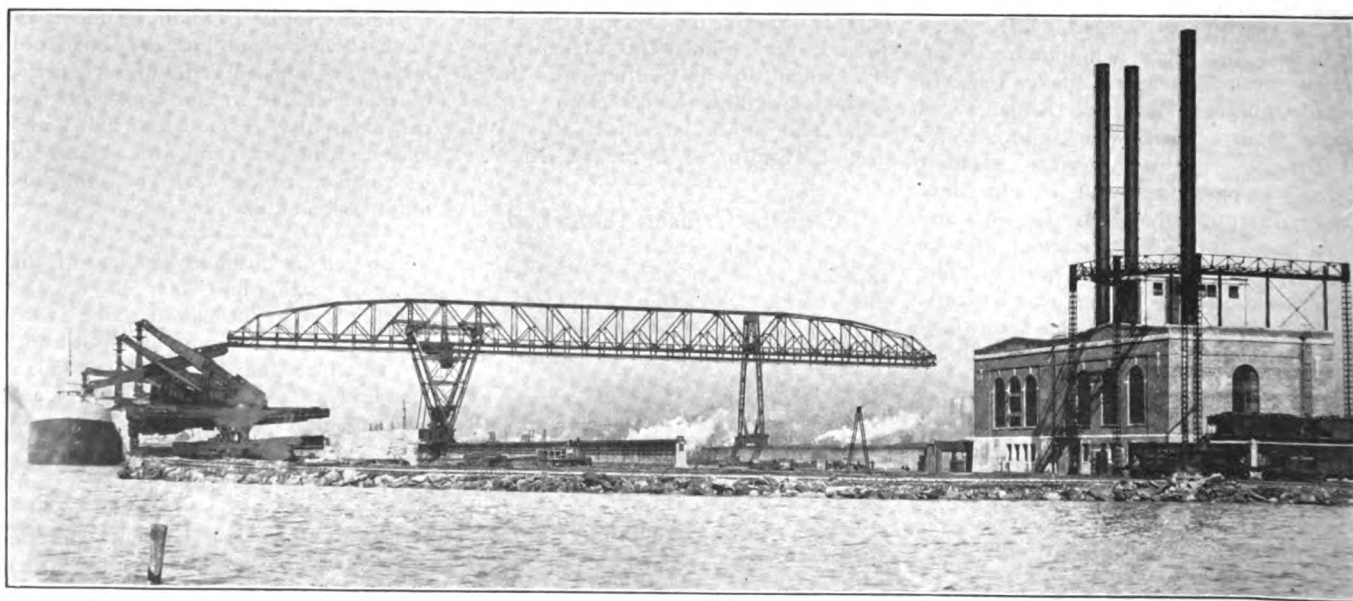
It Went Into Commission on May 1 Unloading Steamer Charles S. Price

—First Development of Cleveland's Outer Harbor for Ore Receiving Purposes

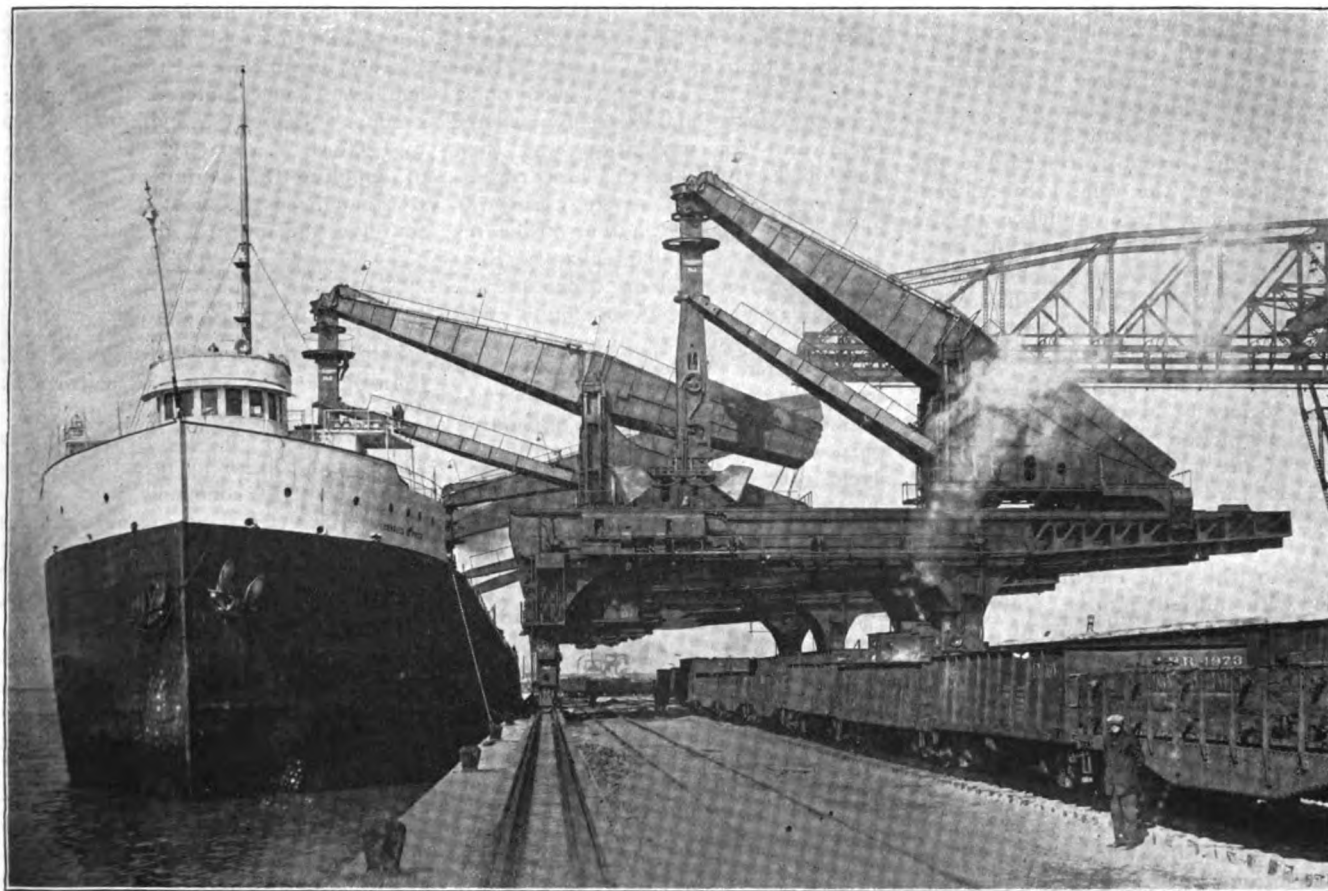
THE steamer Charles S. Price, operated by M. A. Hanna & Co., was the first steamer to unload ore at the new Pennsylvania dock in the outer harbor at Cleveland. She reached the dock on April 27 from Escanaba and unloaded on May 1. A description of the equipment on this new dock was published in the March issue of *The Marine Review*, so extended mention is not now necessary. The departure is signifi-

cant, however, as it is the first use that has been made of the outer harbor at Cleveland for ore receiving purposes. Until now the Pennsylvania had received all of its ore in the old riverbed, which runs at a right angle from the main channel near the mouth of the river. The approach to the old riverbed is complicated by the Lake Shore railway bridge crossing the main channel near this point. As this bridge carries the main traffic of the railway, its constant swinging meant either rail

or vessel congestion. About 40 acres have been filled in in the west breakwater, the new dock having a concrete face of about 800 ft. The ore-handling equipment consists of four 17-ton Hulett unloaders and a 15-ton ore stocking and rehandling bridge built by the Wellman-Seaver-Morgan Co., of Cleveland. These unloaders are the most capacious on the lakes and it is confidently expected later on that a record will be established by them. The ore may be loaded into cars for direct shipment or transferred to a



VIEW OF THE NEW PENNSYLVANIA ORE DOCK IN THE WEST BREAKWATER AT CLEVELAND, SHOWING HULETT UNLOADERS, CONVEYING BRIDGE AND POWER HOUSE



THE NEW PENNSYLVANIA ORE DOCK IN THE OUTER BREAKWATER AT CLEVELAND. THE HULETT UNLOADERS ARE UNLOADING THE CHARLES S. PRICE, THE FIRST STEAMER TO REACH THE NEW DOCK

concrete trough within easy reach of the bridge when it requires to be rehandled. The ore, whether loaded directly into cars or placed in storage, is handled through hoppers which accurately weigh the ore, rendering the use of track scales unnecessary. The plant is electrically operated.

The dock, which was built by the Great Lakes Dredge & Dock Co., is constructed of concrete piling, which was made right on the ground. The ore trough was built by the Dravo Contracting Co., of Pittsburgh.

The development of the outer harbor by the Pennsylvania system is quite complete, including a double track subway under the seven tracks of the Lake Shore railway at Hickory street and a number of electric locomotives for handling the cars under the unloading machines.

Commerce of Sault Canals

The report of the superintendent of St. Marys Falls canal shows that 166,918 net tons of freight passed through the canal in April, 1912, as against 792,587 tons during April, 1911. The American canal carried 114,949 tons as against 51,969 tons for the Canadian canal, reversing last year's

percentage. Both canals opened April 24. The summary is as follows

EAST BOUND.	
Articles.	Total.
Copper, short tons	1,749
Grain, bushels	1,158,299
Building stone, short tons	32
Flour, barrels	120,880
Iron ore, short tons	32,816
Pig iron, short tons	277
Lumber, M. ft. B. M.	923,470
Silver ore, short tons	2,112
Wheat, bushels	40
General merchandise, short tons	
Passengers, number	

WEST BOUND.	
Coal, hard, short tons	46,779
Coal, soft, short tons	12,739
Flour, barrels	
Grain, bushels	
Manufactured iron, short tons	
Iron ore, short tons	
Salt, barrels	
General merchandise, short tons	
Passengers, number	

SUMMARY.	
Vessel passages, number	132
Registered tonnage, net	199,729
Freight—	
East bound, short tons	97,094
West bound, short tons	69,824
Total freight, short tons	166,918

Judge William L. Day of the United States district court has ordered the receivers to sell all of the vessels of the Gilchrist Transportation Co.'s fleet, the company having been unable to meet its financial obligations. Each vessel must be appraised separately and no vessel can be sold for less than two-thirds of her appraised valuation. All sales must be approved by the court.

The Toledo Ship Building Co. launched the passenger steamer Thousand Island for the Thousand Island Steamboat Co., on April 20, Mrs. Harry Parry, wife of the vice president of the steamship company, christening the steamer. The dimensions of the steamer are as follows: Length over all, 172 ft., 6 in.; keel, 164 ft.; beam, 32 ft.; depth, 9 ft., 6 in.

The sand steamer Frank C. Osborn, building for the Pelee Island Sand & Gravel Co., was launched from the Cleveland yard of the American Ship Building Co. on Saturday, April 20, being christened by Miss Margaret Ney, daughter of Robert W. Ney, general manager of the American Steel & Wire Co. The Osborn is 166 ft. over all, 156 ft. keel, 37 ft. beam and 10 ft. deep, and will trade between Pelee Island and Ohio ports.

John C. McHannan, of the Central National Bank, custodian for the Commonwealth Steamship Co., has given the management of the steamer Sheldon Parks to John T. Kelly, of the firm of W. C. Richardson & Co., the steamer J. Q. Riddle to Roy A. Williams and the steamer Abraham Stearn to H. K. Oakes, for the season of 1912.

Dr. Diesel Honored

Starting with the description of the first crudely-constructed engine, which the speaker admitted had never produced a stroke, Rudolph Diesel of Bavaria, the inventor, traced the development of the Diesel oil-fed engine before a large audience in the auditorium of the Engineering Society's building, 29 W. Thirty-ninth street, New York City, Tuesday evening, April 30. Preceding the address, Dr. Diesel was made the recipient of honorary membership in the American Society of Mechanical Engineers. This distinction was conferred on behalf of the council of the society by Col. Edward D. Meier, who had originally introduced the Diesel engine in the United States. Col. Meier briefly spoke of the achievements of Dr. Diesel with oil-fed motive power, and Dr. Humphries, president of the society, then presented the honorary membership. Dr. Diesel fittingly expressed his appreciation of the honor.

In his address, which was illustrated by numerous slides, Dr. Diesel explained the construction of the two and four-cycle, vertical and horizontal types and illustrated the various adaptations that had been made of the engine for general power purposes. A large portion of the address was given to the adoption of the engine in marine service and the speaker cited many interesting examples where the motive power is now in successful use in navigation and of important experiments with it that are now under way by governments and individuals.

First Experimental Diesel Engine

The first experimental Diesel engine was built in 1893, and was of the vertical type, but through some imperfections in design, it could not be operated. It proved, however, according to Dr. Diesel, the soundness of his theory that air could be compressed so highly that it would serve as an ignition agent for internal combustion. In 1897, an 18-H. P. vertical engine was constructed and this proved more successful. In 1901, was built the first complete unit. These early engines were all of the two-cycle type. The four-cycle unit was then developed and in 1911, a 1,100-H. P. unit of this type was constructed. Views of various installations of the engine in power plants in Europe and this country were shown. The largest installation in this country is at Mulberry, Fla., and consists of 16 engines. Views of plants at Pittsfield, Mass., Philadelphia and other places were given.

In the marine field, Dr. Diesel stated that the first engine of the marine type was built in 1902. It was a two-cycle 20 H. P. and was used on a French canal boat. A four-stroke cycle unit for navigation was then developed. In 1905, the first reversing engine of two stroke cycle was developed. In 1908, a four-stroke reversing unit was adapted to a Russian submarine, but in order to obtain the reversing power a quite complicated design was necessary. Dr. Diesel stated that engineers generally from experience favored the two-stroke cycle engine for navigation purposes as against the four-stroke cycle. In the construction of the latest type of two-stroke engine, which is the standard for submarine and smaller duty, Dr. Diesel stated that the tendency in construction was to make it as much as possible resemble the steam engine.

Engines of Large Capacity

Several governments are now secretly experimenting with the Diesel engine, the speaker said, with high cylinder capacity up to 2,000 H. P. If these tests prove successful, Dr. Diesel stated that the building of very large Diesel engines had begun. None of the governments at present are willing to equip warships with oil-fed motive power until the efficiency of the equipment has been fully demonstrated on the high seas.

For navigation purposes, the advantages of the oil-fed engine over the steam engine, according to the speaker, lie in the greater clear deck room, the larger space for cargoes in trading vessels and the greater economy in fuel costs. In warships, the clear deck permits the bringing into play of all the guns upon all sides, greatly increasing their efficiency and power. The position of the engines below the water line increases the protection of the motive power from damage in attacks.

Dr. Diesel spoke of the use of the Diesel engine in sailing vessels, and illustrated some of the important applications of this character. The sailing vessel, *La France*, recently launched at Bordeaux, and which will be the largest vessel of her type afloat, will be equipped with Diesel engines. The *La France* will have a displacement of 10,700 tons. Capt. Amundsen in his recent successful dash to the South Pole, used the oil-fed engine in his vessel, and reported to Dr. Diesel that his engine had worked splendidly under the extreme conditions.

During the past five years, Dr. Diesel has been experimenting in the

use of his engine for tractive purposes and he told his auditors that the first locomotive of the Diesel type had just been completed. The engine used is a two-stroke cylinder of 1,000 to 1,200 H. P. capacity. The problem of applying the engine as a locomotive had been the most difficult of all to solve, the inventor declared.

Book Reviews

Ship Fittings and Wirings, by T. M. Johnson, 5½ x 3 in., 77 pages. D. Van Nostrand Co., New York.

This book is intended to treat in a simple and concise manner the systems of wiring most commonly used in the fitting of electrical apparatus on ships of the mercantile class and does not pretend to cover any of the special appliances and wiring systems in use on warships. The installations of the largest Atlantic liners are very elaborate and expensive, but after all much the same as those of the average vessel except that they are built on a larger scale. This work, however, is confined to the average vessel. Ship work is a special class, requiring skilled and experienced men, as the conditions met with are totally different to those obtaining in the case of similar work on land. There are adverse conditions abroad ship such as vibration and moisture, which penetrates to all parts of the ship. The author discusses electric lighting systems and devotes special chapters to generating sets, dynamo mains, switch boards, circuits, cable and wiring, plugs and sockets, switches, lamps, telephones and jars.

"Marine Directory of the Great Lakes", by Mitchell & Co., compiled by Fred W. Green, 9 x 6 in., 382 pages.

This is the fourth issue of Mitchell & Co.'s Handbook, giving a list of vessel owners, dimensions of lake vessels, including number of compartments in ore carriers, together with segregated lists of passenger boats and car ferries. Information is also given of the ore and coal docks and grain elevators. There is also given a list of all the steamship corporations on the lakes. The pilot rules of the great lakes and the White law are also published.

The steamer *Ontario*, of the Merchants' & Miners' Transportation Co., which was burned and beached on the run from Baltimore to Boston, has been floated and will be repaired.

The Cleveland & Buffalo Transit Co. opened navigation between Cleveland and Buffalo on May 1.

OBITUARY

Capt. James Gourley, the nestor of Chesapeake bay navigators, died at Halethorpe, Md., April 18.

Capt. John F. Gray, formerly connected with the Pittsburgh Steamship Co., but latterly engaged in the fishing business, died at Bay City in April.

Hilary B. Parker, general superintendent of the Royal Mail Steam Packet Co. at Colon, Panama, died on April 22. He was about 55 years old and had been in the west coast service of the line for many years.

Capt. E. G. Crosby of the Crosby Transportation Co., Milwaukee, Wis., lost his life through the foundering of the *Titanic*. He was returning home with his wife and daughter from a visit to the continent.

Christopher Brown, of the shipbuilding firm of A. C. Brown & Co., of Tottenville, S. I., died on April 11, at the age of 78 years. The firm founded by his father and maintained by him was one of the best known in yachting circles.

Samuel Ward Stanton, marine artist, and for many years publisher of the *Nautical Gazette*, went down with the *Titanic*. He was a man of considerable talent and was returning

from Spain, where he had gone to prepare the sketches for mural paintings for the Hudson River Day Line's new steamer, Washington Irving.

William E. Meyer, of the firm of William E. Meyer & Co., steamship and coal contractors of Bermuda, died at Bermuda, on April 25. He was born in Germany 69 years ago, and came to this country when a boy. He served throughout the civil war, reaching the rank of major. Mr. Meyer was associated with Gen. Miles in transporting troops to Porto Rico and later started in business in Bermuda.

Alexander S. Murphy, ex-president of the Maritime Exchange of New York, died on April 12. He was a native of New York City and had been identified with its shipping all his life. He began with the White Star line and was for many years freight manager of the old Union line of steamers. He later entered the service of the Anchor line. For many years he had charge of the bunkering department of Peale, Peacock & Kerr, Inc., retiring from active business in 1909.

Emil L. Boas, American representative of the Hamburg-American Steamship Co., died at his home at Greenwich, Conn., on May 3. He was

born Nov. 15, 1854, at Goerlitz, Germany, and was educated at the Royal Frederick William gymnasium, at Breslau. Mr. Boas came to the United States in 1873 and from 1892 to 1908 had been the general manager of the Hamburg - American line. He succeeded Albert Ballin as director general in 1908. Mr. Boas had many decorations of royal orders. By the emperor of Germany he was made a member of the Knight Royal Prussian Order of the Crown, also of the Order of the Red Eagle; the Chevalier Order St. Mauritius and St. Lazarus by the King of Italy; a knight, first class, Order of St. Olaf, by the king of Sweden and Norway, and commander of the Order of Osmanieh, by the sultan of Turkey. He was a member of the committee of one hundred to meet Prince Henry of Prussia on his visit to the United States in 1902.

Mr. Boas was a member of many business organizations, including the New York chamber of commerce, the Maritime Association, New York Civic Federation. He was a member of the New York Yacht, the Lotus, Deutscher Verein, Liederkrantz and other clubs. His death was due to ptomaine poisoning.

Lake Season of 1912

Navigation opened on the great lakes on April 15 officially, though no vessels left port on that day. No particular attempt was made to navigate the rivers until May 1, and probably it will be the middle of the month before there is any general movement. There is still more or less ice floating in the open lake and masters have been cautioned to be careful about running into it. All the leading ore shippers have entered the market for tonnage and have practically covered their season's requirements at rates which work out at five cents less to the vessel than last year's rate, that is to say, 40 cents net from the head of the lakes, 35 cents from Marquette and 25 cents from Escanaba.

While no official announcement has been made of the unloading rate, the docks are operating on the assumption that it will be 10 cents. The railways will fix the rate at 10 cents unless the Interstate Commerce Commission should rule otherwise.

The season is expected to be a good one as soon as it opens up, as every shipper has covered tonnage. It is, of course, merely guesswork to predict the season's movement at this time, but the trade is looking forward to a movement of over 40,000,000 tons. A considerable fleet carrying coal left port as soon as the rivers could safely be navigated, but since then the coal trade has been light, very little coal arriving at Lake Erie ports.

Tug Ontario Launched

The United States government tug Ontario was launched at the yard of the New York Ship Building Co., Camden, N. J., on April 11, being christened by Mrs. F. A. Hunnewell, wife of the chief naval draftsman stationed at the works of the company. The Ontario is 183 ft. long over all, 34 ft. breadth molded and 20 ft. deep. She is of steel, rigged with two pole masts. Her propelling machinery consists of a triple-expansion engine with cylinders 19¾, 31½ and 54½ in. in diameter by 36 in. stroke. Steam is supplied by two Scotch boilers 16 ft. diameter and 11¼ ft. long with a heating surface of 5,770 sq. ft.

Personal Mention

William F. Gorsech, of the Maryland Steamboat Co., recently organized in Baltimore, is now arranging for terminals at Seaford, Md.

Charles M. Schwab, president of the Bethlehem Steel Corporation, is reported to be contemplating the establishment of a dry dock at San Francisco to be 1,250 ft. long.

Rear Admiral R. F. Nicholson, chief of the bureau of navigation, says that 89 per cent of the men in the service, exclusive of officers, are American born and that 96 per cent are citizens.

Lieut. Col. Edward Burr, corps of engineers, U. S. A., has been assigned to visit the Panama canal on business pertaining to the defenses of the waterway.

Leonard Joseph, president of the Phoenix Iron & Steel Co., Galveston, Tex., announces the establishment of a new steamship line between Galveston and Genoa to engage in the scrap iron and cotton trade.

R. Kafuku, general manager of the Osaka Shosen Kaisha, is in the United States investigating the probable influence of the opening of the Panama canal upon the business of his company.

DeCourcy May has been made chairman of the board of directors of the New York Ship Building Co. Samuel M. Knox becomes president and J. I. Wickersham secretary and treasurer.

A. M. Dollar, vice president of the Dollar Steamship Co., of San Francisco, was made a guest of the city of Long Beach, upon his recent visit there to confer with the officials of the Craig Ship Building Co., regarding the building of a new steel steamer.

Julius Thomann, director of the Hamburg-American line, who arrived in this country on the Kaiserin Augusta Victoria, says that he does not anticipate any prejudice against the big ship on account of the Titanic disaster. His company is now building the Emperor, a 900-ft. liner.

Willard U. Taylor has been elected president of the Maritime Association of the port of New York. William Simmons is vice president, and Frederick V. L. Jones, treasurer. The new directors are Daniel Bacon, John Dowd, John C. Eustace, Eugene F. Moran, Max M. Normann and Bernard L. Tim.

William T. Donnelly, president of the Brooklyn Engineers' Club, which is holding an exhibit in Brooklyn, has loaned to the exhibition a work-

ing model of the Piercy locomotive stage, a contrivance which rests on the bottom of the sea or river and "walks" from place to place without having a single bolt or connection removed.

Alfred A. Booth, chairman of the Cunard line, expresses the hope that before very long the public opinion of Great Britain as a whole will demand some protection against the recurrence of such a national calamity as a general coal strike. The leaders of the trade union movement have apparently not learned that such a strike is economically disastrous to the workingman.

Emery R. Johnson, professor of transportation and commerce in the University of Pennsylvania and special commissioner on Panama traffic and tolls, in a statement made before the senate says that the operation of the canal will cost the government \$30,000,000 per annum, divided as follows: Operating expenses, \$4,000,000; interest on investment, \$11,000,000, and military establishment of canal zone, \$15,000,000.

Ore on Dock May 1

Statistics gathered by THE MARINE REVIEW from the various dock managers at Lake Erie ports show that the amount of ore on Lake Erie docks, May 1 of the present year, was 5,881,245 tons, as against 6,850,285 tons in 1911, a decrease of 969,040 tons.

The total rail shipments from Lake Erie ports to furnaces during the winter season (Dec. 1 to May 1) aggregate 3,250,419 tons, viz.:

On dock Lake Erie ports, Dec. 1, 1911 9,131,664 tons
On dock May 1, 1912 5,881,245 tons

By rail to furnaces, winter of 1911-12 3,250,419 tons

Adding these winter shipments to 23,178,370 tons, the amount shipped to furnaces during the navigation season of 1911, gives 26,428,789 tons as the entire consumption of ore from Lake Erie ports during the year ended May 1, 1912, as against 32,636,692 for the year ended May 1, 1911; as against 33,599,013 tons for the year ended May 1, 1910; as against 20,524,523 tons for the year ended May 1, 1909; as against 31,692,446 tons for the year ended May 1, 1908; as against 30,099,769 tons for the year ended May 1, 1907; as against 28,984,358 tons for the year ended May 1, 1906; 20,057,070 tons for the year ended May 1, 1905; 18,739,995 tons for the year ended May 1, 1904; 21,905,251 tons for the year ended May 1, 1903; 17,216,065 tons

for the year ended May 1, 1902; 14,465,260 tons for the year ended May 1, 1901; 15,882,881 tons for the year ended May 1, 1900; 12,122,982 tons for the year ended May 1, 1899, and 10,209,488 tons for the year ended May 1, 1898.

The following table gives the amount of ore on dock at the close of navigation last year and the opening this year:

Ports	May 1, 1912	Dec. 1, 1911
Toledo	356,102	661,382
Sandusky	2,471	2,471
Huron	257,496	344,371
Lorain	287,294	314,321
Cleveland	1,363,696	1,589,491
Fairport	381,705	636,566
Ashtabula	2,108,749	3,295,862
Conneaut	229,462	1,237,573
Erie	585,150	636,274
Buffalo	309,120	413,333
	5,881,245	9,131,664

April Ore Shipments

Ore shipments during April were 204,042 tons as against 331,645 tons shipped during April, 1911, a decrease of 127,603 tons. During April, 1910, the fleet moved 1,520,305 tons, the season opening that year with a great rush, much to the regret of vessel owners later when they were compelled to withdraw a fair portion of their vessels from the trade. Shipments by ports were as follows:

Port	April, 1911	April, 1912
Escanaba	93,532	80,530
Marquette	14,838	
Ashland	41,337	8,288
Superior	76,739	64,416
Duluth	51,042	18,237
Two Harbors	54,157	32,571
Total	331,645	204,042
1912 decrease		127,603

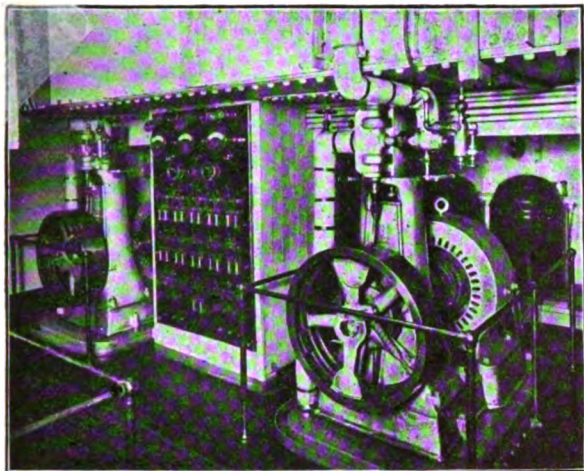
The Robins Dry Dock & Repair Co., Erie Basin, Brooklyn, has given contract to Harry Cossey, Tottenville, S. I., for a floating wooden dry dock, which, when completed, will be the largest structure of its kind in the United States. It is to be capable of lifting 24,000 tons.

In view of increasing business, J. W. Isherwood, inventor of the longitudinal system of ship construction, has established his headquarters at No. 4 Lloyds avenue, London, E. C.

The seven steamers of the Pioneer Steamship Co., which are managed by Hutchinson & Co., will be operated without insurance during the present season.

Prangle, Hagerty & Wright, of Toronto, have given contract to the Collingwood Ship Building Co. for a 9,000-ton steamer.

The name of the Union Steamboat Line has been changed to the Erie Railroad Transit Line.



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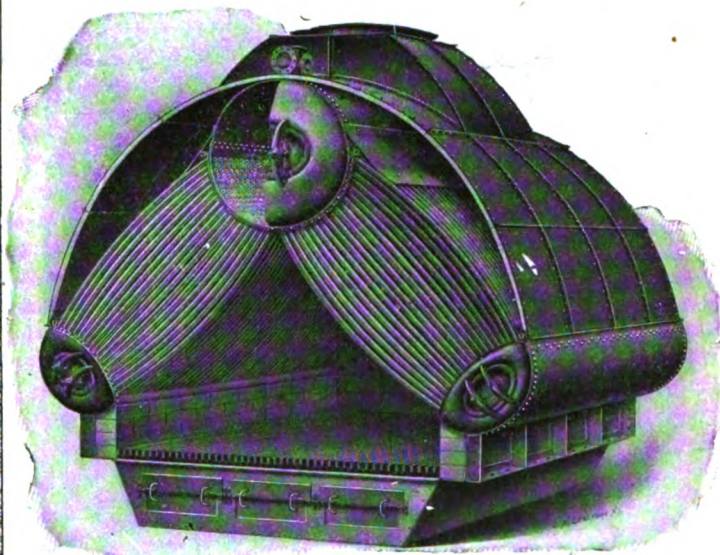
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Mosher Water Tube Boilers



Adapted for the highest grade service, Torpedo Boats, Destroyers, Battleships, and large commercial vessels. Steam drums up to six feet in diameter, larger water and steam room capacity than any other boiler.

Any tube can be replaced without disturbing any others. Fifty tubes removed through one hand-hole. Curvature of tubes just sufficient to avoid expansion troubles. Greatest facility for cleaning interior and exterior of tubes. No screwed joints, all tubes expanded. All parts of wrought steel. Send for catalogue.

MOSHER WATER TUBE BOILER CO.
30 Church Street, NEW YORK

Steamboat Inspection Rulings

The following are copies and excerpts from letters written during the month of April, 1912, wherein rulings have been handed down relative to the interpretation of certain of the revised statutes, and also sections of the rules and regulations, relating to the steamboat inspection service, all of which are submitted for your information and guidance.

Under date of April 3, 1912, the bureau advised the Falls Hollow Staybolt Co., of Cuyahoga Falls, O., "that screw staybolts that have been rolled hollow with a $\frac{1}{8}$ -in. hole throughout their entire length may be used, as well as screw staybolts that have been drilled at the ends with a $\frac{1}{8}$ -in. hole."

Upon affidavit duly made by the American-La France Fire Engine Co., of Elmira, N. Y., that the Buscoba hand fire extinguisher is identical with the Alert fire extinguisher, which has been approved by the Board of Supervising Inspectors, the only difference being in the name plate, such difference being limited to the brand or trade name and the firm name and address of the Bush-Scott Co., Detroit, Mich., this bureau, under date of April 3, 1912, advised the Bush-Scott Co. that the Buscoba fire extinguisher may be used on vessels required by law to be provided with fire extinguishers, and will be listed in future editions of the rules and regulations as an approved fire extinguisher.

Under date of April 15, 1912, the bureau advised the Supervising Inspector of the Fifth district, with reference to amended paragraph of section 48, rule 5, which reads as follows:

Any person who received a license prior to the adoption of the rule demanding a visual examination may have such license renewed for daylight navigation only, if no other bar to such renewal appears.

"That the rule demanding a visual examination for license as pilot of steam vessels was adopted in the year 1880, and that the rules applying to and including various classes of masters, mates, and pilots of steam, motor, and sail vessels were amended in various years, and the year of adoption of the rule applying to any class of officers would be the year in which the class was first included in the visual rules.

"Section 10, rule 5, as amended in the year 1899, included masters and mates of ocean or coastwise steamers, pilots of steam vessels, and masters

and chief mates of sailing vessels. Section 10, rule 5, as amended in 1903, also included masters and mates of steam pleasure yachts. In 1905, the rule (section 49, rule 5) was amended to include masters, mates, and pilots of vessels propelled in whole or in part by steam, gas, fluid, naphtha, also vapor, electric, or other like motors, and masters and mates of sail vessels."

During April, 1912, the following named companies submitted affidavits required by section 20, rule 2, general rules and regulations, relative to valves and fittings: Manistee Iron Works Co., Manistee, Mich.; The Atlantic Works, East Boston, Mass.

Union Castle Line Bought

The Royal Mail Steam Packet Co. recently purchased in London the fleet and good will of the Union Castle Steamship Co., paying \$25,867,863 for the business. This makes the Royal Mail the largest steamship company in the world with a total tonnage of 1,380,570. Its nearest competitor is the Hamburg-American Line with a total of 1,210,000 tons. The companies, steamships and tonnages now controlled by the Royal Mail Steam Packet Co. are as follows:

	Ships.	Tonnage.
Royal Mail Steam Packet Co.	49	258,333
Elder-Dempster	112	338,735
Lamport & Holt	46	319,197
Union Castle	44	249,611
Pacific Steam Navigation Co.	37	182,716
Glen & Shire Lines	7	31,978
	295	1,380,570

The importance of this combination is far-reaching, as these companies jointly touch all quarters of the globe, being as notably active in the East and West Indies as in South American and African trades. The price paid for the Union Castle Line was more than three times the market value of the shares. It is significant that one of the active promoters of the combination is Lord Pirrie of the firm of Harland & Wolff, who is interested in the White Star Line and consequently in the International Mercantile Marine Co.

Turbine Driven Fans

The turbine-driven fan for forced draft is now the accepted standard in the United States navy, taking the place of the former forced draft sets consisting of fan driven by high speed engine. The new turbine sets deliver 28,000 cu. ft. of free air per minute against 5-inch static pressure water gage in the stokehold. Two sets are placed in each stokehold and the turbine is hung from girders directly beneath the ventilator cowls. Of the eight

United States destroyers recently contracted for, seven will have four Terry turbine driven forced draft sets.

A Condenser Tube for Marine Work

In marine work there has always been a need for a condenser tube that had a reasonably high coefficient of heat transfer and could successfully withstand the corrosive action of the salt water used for cooling purposes. Therefore the tests made on a Monel metal condenser tube by George A. Orrok and presented in his paper on the "Transmission of Heat in Surface Condensation", read before the American Society of Mechanical Engineers are of considerable interest as the Monel metal tube showed a co-efficient of heat transfer of 0.75 in comparison to copper's 1.00, but the great advantage of the Monel metal tube is that it is less corrodible than bronze, as strong as steel, and the finish is similar to pure nickel.

It is rumored that the owner of the French four-masted barque Quevilly, have decided to take the Diesel engines out of the vessel from which it would appear that they have not been a success. The vessel, which is 2,418 tons register, is the largest sailing ship under the French flag and was built for carrying petroleum in bulk, being fitted with Diesel oil engines driving twin screws. It is rumored that on one voyage this vessel took about twice the time she would ordinarily have taken had she not been fitted up with auxiliary power, the reason stated in some quarters being that the twin screws acted as a drag on the vessel.

Harry L. Brown & Co., Stewart Iron Co., Ltd., the Brown Steamship Co., the Northwestern Transportation Co. and the president and treasurer of the Brown Hoisting Machinery Co. announce the removal of their offices from the Perry-Payne building to 1624 Rockefeller building, Cleveland.

The Great Lakes Dredge & Dock Co., of Chicago, was the lowest bidder for the construction of the east approach of the canal leading to the new American lock at Sault Ste. Marie. Its bid was \$395,750.

F. H. Osborn & Co., insurance agents of Chicago, have moved their offices to the Insurance Exchange building.